Office of Space Science
& Applications

OSSA

FLIGHT PROJECT DATA BOOK 1989

NASA
National Aeronautics and
Space Administration

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OFFICE OF SPACE SCIENCE AND APPLICATIONS FLIGHT PROJECT DATA BOOK

PROJECT **PAGE**

OFFICE OF SPACE SCIENCE AND APPLICATIONS
FLIGHT PROJECT DATA BOOK

THE OFFICE OF SPACE SCIENCE AND APPLICATIONS
INTRODUCTION

The Office of Space Science and Applications (OSSA) is responsible for planning, directing, executing, and evaluating that part of the overall NASA program that has as its goal the utilization of the unique characteristics of the space environment to conduct a scientific study of the universe, to solve practical problems on Earth, and to provide the scientific research foundation for expanding human presence beyond Earth into the solar system. OSSA guides its program toward leadership through its pursuit of excellence in space science and applications across a full spectrum of disciplines. The drive for excellence, combined with the active achievement of program goals, firmly positions the U.S. space science and applications for an exciting, productive future.

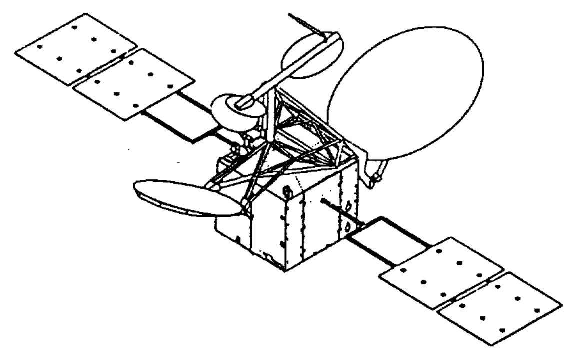
OSSA manages the development of NASA's flight instrumentation for space science and applications including free-flying spacecraft, Shuttle and Space Station payloads, and the suborbital sounding rockets, balloons, and aircraft programs. OSSA also sponsors the analysis of the data returned from these missions, maintains an extensive research and analysis program, and is responsible for the management of the Goddard Space Flight Center and the Jet Propulsion Laboratory.

This document provides a summary of future flight missions, including those approved and currently under development and those which appear in the OSSA strategic plan.

ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS)

Objective

- Maintain U.S. leadership in satellite communications
- Provide advanced communications technology for NASA missions and other government agencies
- Test and verify advanced technologies including:
  - High power, fast hopping spot-beam antennas
  - Ka Band (30/20 GHz) components
  - On-board processing and switching
- Test and demonstrate key ACTS technologies through an experiment program with participation by telecommunications end users, service, and product providers.



Description

The ACTS spacecraft will be launched from the Shuttle via a Transfer Orbit Stage (TOS) into geostationary orbit. Following launch and checkout, a 2- to 4-year program is planned for user-funded experiments.

Launch Date:	1992
Payload:	Communications
Orbit:	Geostationary orbit, 0 degree inclination, 100 degrees W
Design Life:	2 years (4 years of station keeping)
Length:	9 m
Weight:	2,733 kg (ACTS) cargo element weight
Diameter:	4.3 m (static payload envelope)
Launch Vehicle:	Shuttle, TOS
Foreign Participation:	None

Mission Events

Design and fabrication: 1984-1992
Experiment period: 1992-1994

Management

NASA Headquarters
D. Olmstead, ACTS Manager
W. Kondik, Experiments Program Manager
Lewis Research Center
R. Gedney, Project Manager
R. Schertler, Experiments Manager
Major Contractors
GE AstroSpace Division (Formerly RCA Astrospace)
COMSAT Laboratories
Motorola, Inc.

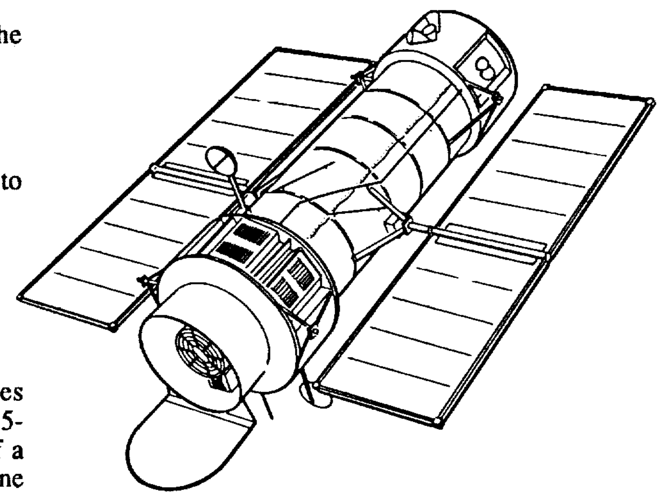
ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS)
(Continued)

Status

GE AstroSpace Division's predecessor, RCA Astro, was awarded the prime contract for development of the ACTS system in August 1984. Current major contractors are GE AstroSpace with Motorola as a major subcontractor and COMSAT Labs. Lewis Research Center is responsible for overall system design between the flight system (GE) and the ground based system (COMSAT) and will also directly manage the contract for NASA ground station and master control station development being carried out at COMSAT Labs.

ADVANCED X-RAY ASTROPHYSICS FACILITY (AXAF)

Objective



- Obtain high resolution X-ray images and spectra in the 0.1 to 10 keV wavelength range
- Investigate the existence of stellar black holes
- Study the contribution of hot gas to the mass of the universe
- Investigate the existence of dark matter in galaxies
- Study clusters and superclusters of galaxies
- Investigate the age and ultimate fate of the universe
- Study mechanisms by which particles are accelerated to high energies
- Confirm validity of basic physical theory in neutron stars
- Investigate details of stellar evolution and supernovae

Description

AXAF is the X-ray element of the Great Observatories program. It is a free-flying observatory with a goal for a 15-year operational lifetime. The AXAF telescope consists of a nested array of grazing incidence mirrors, up to 4 focal plane science instruments, 2 sets of objective grating, and a PI-developed science payload unit. This telescope, with a geometric collecting area of 1,700 square cm and an 0.5 arcsecond angular resolution, will provide at least a 100-fold increase over its predecessor (HEAO-2).

Launch Date:	FY 1996
Payload:	Up to 4 focal plane instruments and 2 non-focal plane instruments
Orbit:	600 km, circular orbit, inclined 28.5 degrees
Design Life:	15 years with servicing
Length:	Approximately 14 m
Weight:	Approximately 12,000 kg
Diameter:	Approximately 4 m
Launch Vehicle:	STS
Foreign Participation:	Federal Republic of Germany, The Netherlands, United Kingdom

Mission Events

TRW Phase C/D contract initiation: FY 1989
Initiation of science instrument development: FY 1990
Completion of largest mirror pair: FY 1991
Launch date: FY 1996

Management

NASA Headquarters
A. Fuchs, Program Manager
A. Bunner, Program Scientist
Marshall Space Flight Center
F. Wojtalik, Project Manager
M. Weisskopf, Program Scientist
Major Contractor
TRW, Inc.

ADVANCED X-RAY ASTROPHYSICS FACILITY (AXAF) (Continued)

Status

AXAF Mission Development Program has been initiated
Science instruments have been selected and will continue in extended definition through calender year 1989

ASTRO-1, 2

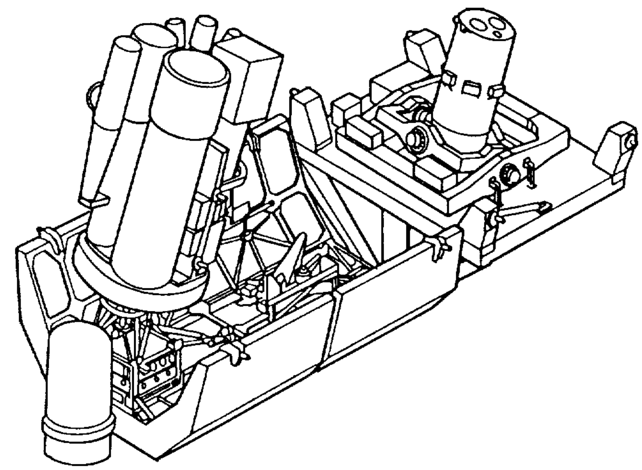
Objective

- Study the behavior of quasars, galaxies, and active nuclei in the far ultraviolet
- Investigate the behavior of hot stars and galaxies in broad ultraviolet wavelengths with a wide field of view
- Explore polarization characteristics of hot stars, galactic nuclei, and quasars
- Measure the amount of energy of X-ray emission from active galaxies, cluster of galaxies, supernova remnants, and stars

Description

Astro is an Astrophysics Spacelab payload consisting of four separate, yet complementary, optical instruments. These are: 1) three ultraviolet (UV) telescopes aligned to each other on a single pointing system on two Spacelab pallets and 2) an X-ray telescope mounted on a separate pointing system secured by a special support structure. These four instruments are capable of performing independent of simultaneous observations of selected targets. Together, this complement of instruments obtains scientific measurements in the electromagnetic spectrum wavelength between 0.12A and 3500A and works together to perform up to 200-300 independent observations during a typical 9-10 day mission.

Astro-2 is currently manifested to fly as Astro-1 except without the X-Ray telescope, separate pointing system, and special support structure.



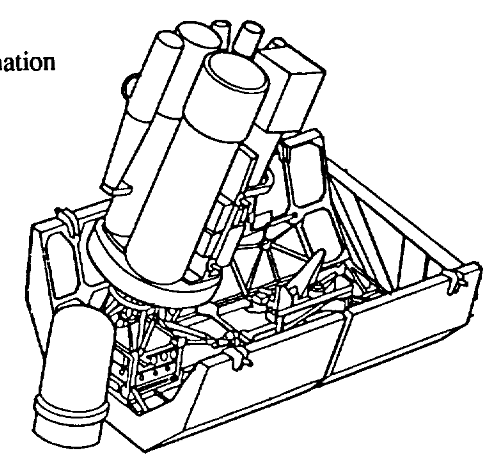
ASTRO-1 Configuration

Launch Date:	Astro-1: March 1990 Astro-2: August 1992
Investigations:	4
Orbit:	352 km altitude at 28.5 degree inclination
Duration:	9-10 days
Weight:	14,067 kg
Launch Vehicle:	STS
Foreign Participation:	None
Payload Specialists:	2

Mission Events

ASTRO-1

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Cargo Integration Review: February 1989
Broad Band X-Ray Telescope delivery to KSC: August 1989
Flight Readiness Review: February 1990



ASTRO-2 Configuration

ASTRO-1, 2 (Continued)

Management

NASA Headquarters
W. Huddleston, Program Manager (Flight Systems Division)
E. Weiler, Program Scientist (Astrophysics Division)
Marshall Space Flight Center
J. Jones, Mission Manager
E. Urban, Deputy Mission Scientist
Goddard Space Flight Center
F. Volpe, BBXRT Payload Manager
T. Gull, Mission Scientist
Major Contractors
Teledyne Brown

Status

UV instruments undergoing integration at the Kennedy Space Center. The BBXRT X-ray telescope and Two-Axis Pointing System (TAPS) with its special support structure is undergoing final tests and integration at GSFC.

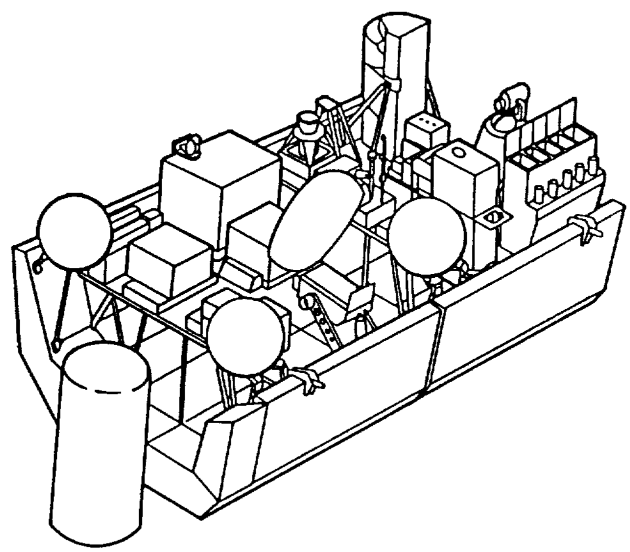
Payload specialists for the Astro missions are:

1. Dr. Ronald A. Parise--selected as a member of flight crew for Astro-1 mission
2. Dr. Samuel T. Durrance--selected as a member of flight crew for Astro-1 mission
3. Dr. Kenneth H. Nordsieck--will serve as back-up payload specialist for Astro-1 mission.

ATMOSPHERIC LABORATORY FOR APPLICATIONS AND SCIENCE (ATLAS)

Objective

- Measure long-term changes in the total energy radiated by the Sun
- Determine the variability in the solar spectrum
- Measure the global distribution of key molecular species in the middle atmosphere
- Differentiate man-made from natural perturbations in the Earth's atmosphere
- Provide absolute calibrations for solar monitoring instruments on free-flyer spacecraft



Description

The first ATLAS mission will use two Spacelab pallets and an igloo to accommodate a core payload of solar and atmospheric monitoring instruments plus reflights of some Spacelab investigations. Later missions at 1- to 2-year intervals will have a single pallet. The Orbiter orientation will either be inertially fixed so that selected instruments are pointed at the Sun or nadir for observations of the Earth's atmosphere. The orbit must have solar occultations so that absorptions in the solar spectrum caused by trace molecules in the atmosphere can be detected by the ATMOS instrument, and infrared spectrometer with a mirror system to track the Sun. Command, control, and data handling support for the experiments are provided by Spacelab's avionics located in the igloo. The crew will work at the aft flight deck, which has the displays and controls needed to conduct the ATLAS investigations.

ATLAS-1 Launch Date:	ATLAS-1: May 1991 ATLAS-2: June 1992 ATLAS-3: May 1993 (planned) ATLAS-4: April 1994 (planned)
Investigations:	13
Orbit:	250 km altitude, 57 degree inclination
Duration:	7-10 days
Weight:	ATLAS-1 = 9,090 kg (target) ATLAS-2 = 6,400 kg (planned) ATLAS-3 = 6,364 kg (planned)
Launch Vehicle:	STS
Foreign Participation:	West Germany (Microwave Atmospheric Sounder), Belgium (Solar Constant Radiometer, Grille Spectrometer), France (Solar Spectrum Irradiance Monitor, Investigation on Atmospheric H and D through the Measurement of Lyman-Alpha), Japan (Space Experiments with Particle Accelerators)
Payload Specialists:	2

Mission Events

ATLAS-1

- Critical Design Review: April 1989
- Cargo Integration Review: November 1989
- Flight Readiness Review: April 1989

ATMOSPHERIC LABORATORY FOR APPLICATIONS AND SCIENCE (ATLAS) (Continued)

Mission Events (continued)

ATLAS-2

- Instrument delivery to KSC: September 1991
- Flight Readiness Review: May 1992

Management

NASA Headquarters
E. Montoya, Program Manager
D. Butler, Program Scientist
Marshall Space Flight Center
T. O'Neil , Mission Manager
T. Miller, Mission Scientist
Major Contractors
Teledyne Brown

Status

The payload specialists for this mission are:

1. Dr. B. Lichtenberg--selected as member of flight crew for ATLAS-1 mission
2. Dr. M. Lampton--selected as member of flight crew for ATLAS-1 mission
3. Dr. C.R. Chappell--will serve as back-up payload specialist for ATLAS-1 mission
4. Dr. D.D. Frimout--will serve as back-up payload specialist for ATLAS-1 mission.

The instrument development is nearly complete and the mission design and integration is well underway. Mission Critical Design Review is scheduled for April 1989.

CRYOGENIC INFRARED SPECTROMETER TELESCOPE FOR ATMOSPHERE/EXPLORATION VARIABILITY (CRISTA/EAV)

Objective

Measurement of trace gas composition by infrared remote sensing atmospheric limb scan. Investigation waves, medium and small scale structures in the atmosphere with high spatial and temporal resolution within the spectral range of 1 to 150 micrometers

Description

CRISTA is a 1 meter cryogenically cooled telescope assembly carried in the space shuttle payload bay on a German ASTRO-SPAS (Shuttle PAllet Satellite) support structure. CRISTA is the second planned ASTRO-SPAS mission. CRISTA consists of a German telescope/cryostat assembly in 4-70 micrometer spectral range, containing U.S. experiments in Infrared Measurements of the Atmosphere (IRMA, 60-150 micrometer) and Airglow Measurement of Infrared Emission (AMIE, 1 - 2 micrometers) The payload operates at a distance of approximately 4 km from the Orbiter following deployment using the Shuttle's remote manipulator system. This ASTRO-SPAS payload is 1.7 meters in length, with on-board battery, cryogenic and N_2 cold-gas maneuvering subsystems. Maximum uplink telemetry data rate is 16 kbps. CRISTA/SPAS is retrieved at the end of the mission and returned to Earth with the Orbiter CRISTA, together with its co-manifested NASA payload (ATLAS-3), will constitute a joint science mission with a single set of science objectives managed by a single management structure.

Launch Date:	May 1993
Investigations:	1 instrument/3 investigation regions
Orbit:	250 km altitude, 57 degree inclination
Duration:	7-10 days
Weight:	3,500 kg (max)
Launch Vehicle:	STS
Foreign Participation:	Germany (Berische Univeritat Gesamthochschule) to provide CRISTA telescope. German DLR provides ASTRO-SPAS carrier.

Mission Events

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
ASTRO-SPAS development/fabrication: On-going, target completion: September 1990
CRISTA instrument Phase B design Study: Completed
CRISTA instrument fabrication: Ongoing, target completion: June 1991

Management

NASA Headquarters
L. Demas, NASA/ASTRO-SPAS Lead Coordinator
L. Demas, CRISTA Mission Coordinator (Flight Systems Division)
G. Esenwein, Program Scientist (Astrophysics)
Marshall Space Flight Center
T. O'Neil, Mission Manager (ATLAS)
T. Miller, Mission Scientist (ATLAS)
Johnson Space Center
M. Brekke, Payload Integration Manager

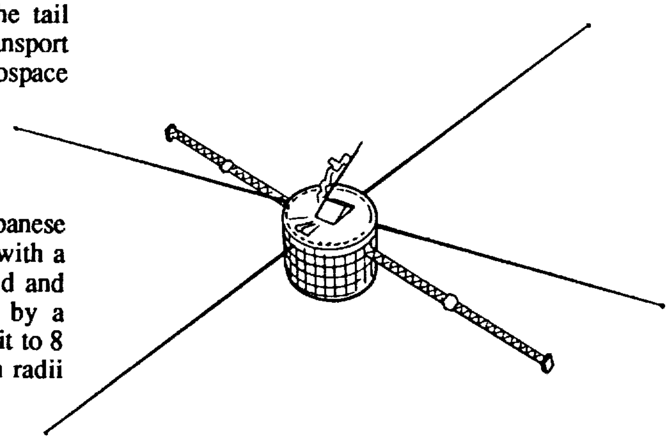
Status

CRISTA and ASTRO-SPAS hardware are being fabricated with a late 1991 target integration date. U.S.-German joint ASTRO-SPAS program memorandum of understanding is in its final review, with detailed science letters of agreement on individual missions (including CRISTA) to be developed in early 1989.

COLLABORATIVE SOLAR-TERRESTRIAL RESEARCH (COSTR) PROGRAM
GEOTAIL MISSION

Objective

Characterize the energy stored in the Earth's geotail and mid-magnetosphere region including measurements in the tail plasma sheet and measurements of plasma entry and transport in the magnetosphere boundary layer for the Global Geospace Science (GGS) program.



Description

Geotail is a spin-stabilized spacecraft provided by the Japanese Institute of Space and Astronautical Sciences (ISAS) with a full range of shared ISAS/NASA plasma physics field and particles instrumentation. Geotail will be launched by a NASA/ELV into a night side double lunar swingby orbit to 8 x 250 Earth radii and later reduced to an 8 x 32 Earth radii equatorial orbit.

Launch Date:	July 1992
Orbit:	Double lunar swingby to a 250 Earth radii and an 8 x 32 Earth radii equatorial orbit x 7 degree inclination
Design Life:	3 years
Length:	2.3 m
Weight:	850 kg
Diameter:	2.2 m
Launch Vehicle:	Medium ELV
Foreign Participation:	Cooperative program with Japanese ISAS

Mission Events

Sign MOU: 1989
Engineering unit integration test: 1989
US instrument flight model deliveries: 1989
Flight unit CDR: 1989

Management

NASA Headquarters
M. Calabrese, Program Manager
S. Shawhan, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Major Contractors
Instruments to be supplied by principal investigators

Status

Engineering unit CDR complete
MOU in final concurrence loop
MLV RFP being issued by NASA
Integration of engineering unit of multichannel analyzer (MCA) for U.S. (University of Iowa) with Japanese plasma wave experiment engineering unit completed

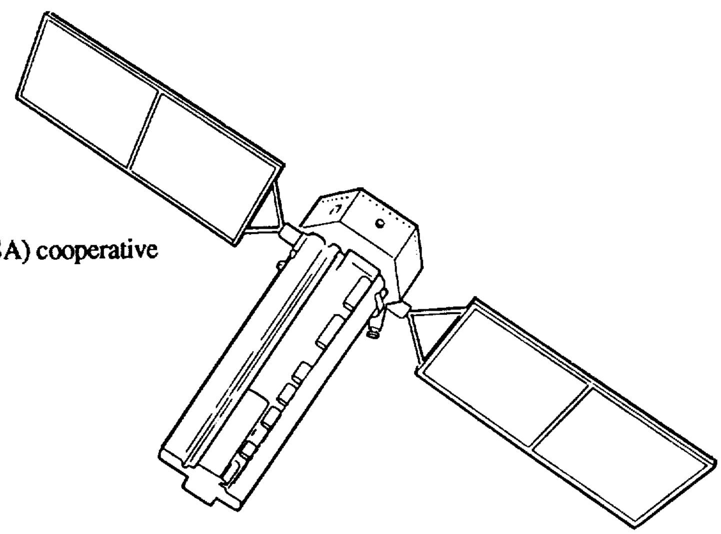
COLLABORATIVE SOLAR-TERRESTRIAL RESEARCH (COSTR) PROGRAM
SOLAR AND HELIOSPHERIC OBSERVATORY (SOHO) MISSION

Objective

Perform remote measurements of the sun and in situ measurements of the solar wind to characterize the structure of the solar interior and the dynamics of coronal plasma.

Description

SOHO is a three-axis stabilized spacecraft with shared ESA/ NASA solar physics and plasma physics field and particles instrumentation launched by NASA into a halo orbit at the Sun-Earth L_1 Lagrangian point.



Launch Date: March 1995
Orbit: Halo at L_1 libration point
Launch Vehicle: ELV (ATLAS-II-type)
Design Life: 2 years
Length: 3.6 m
Weight: 2,000 kg
Diameter: 3.6 m
Foreign Participation: European Space Agency (ESA) cooperative

Mission Events

Initiate instrument development: 1989
Initiate spacecraft development: 1990

Management

NASA Headquarters
M. Calabrese, Program Manager
D. Bohlin, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Major Contractors
Instruments to be supplied by principal investigators

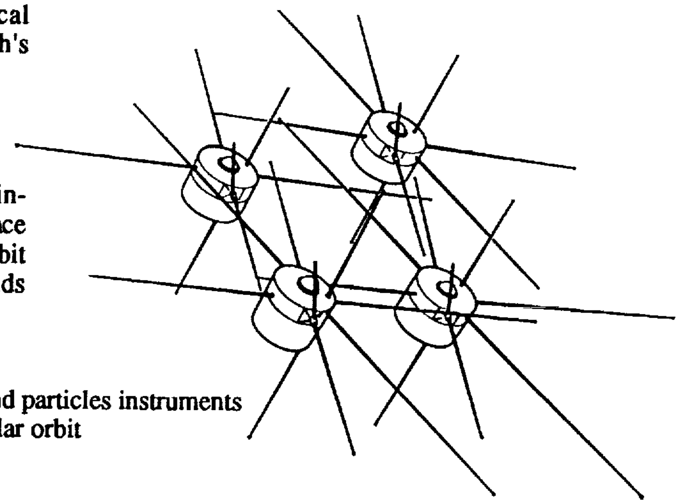
Status

Investigations being defined
    Second science working team meeting held in February 1989
Spacecraft contractor proposals under evaluation at ESA
    Award in October 1989 to conduct Phase B studies
Launch vehicle identification in process at NASA
MOU in final concurrence loop
Program plan in preparation

COLLABORATIVE SOLAR-TERRESTRIAL RESEARCH (COSTR) PROGRAM
CLUSTER MISSION

Objective

Perform three-dimensional studies of the microphysical properties of different plasma states in the Earth's magnetosphere.



Description

Cluster consists of four identically instrumented, spin-stabilized spacecraft built and launched by the European Space Agency (ESA) into a 3 x 20 Earth elliptical radii polar orbit with a full range of shared ESA/NASA plasma physics fields and particles instrumentation.

Launch Date:	December 1995
Payload:	Space plasma physics fields and particles instruments
Orbit:	3 x 20 Earth elliptical radii polar orbit
Design Life:	2 years
Length:	4 m
Weight:	4,000 kg
Diameter:	2.9 m
Launch Vehicle:	Ariane-V
Foreign Participation:	European Space Agency (ESA) cooperative

Mission Events

Initiate instrument development: 1989
Initiate spacecraft development: 1990

Management

NASA Headquarters
M. Calabrese, Program Manager
S. Shawhan, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Major Contractors
Instruments to be supplied by principal investigators

Status

Investigation being defined in 1988-1989
- Second Science Working Team meeting held in February 1989

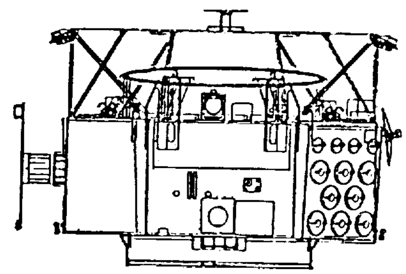
Spacecraft contractor proposals under evaluation
- Award in October 1989 to conduct Phase B studies

MOU in final concurrence loop
Program plan in preparation

COMBINED RELEASE AND RADIATION EFFECTS SATELLITE (CRRES)

Objective

- Study effects of natural radiation and microelectronic devices
- Characterize the geospace electrical, magnetic and radiation environment
- Evaluate performance of gallium arsenide solar cells
- Study interaction of plasmas with the magnetosphere
- Study the coupling of the upper atmosphere with the ionosphere
- Study the structure and chemistry of the ionosphere



Description

CRRES is a joint project of NASA and the U.S. Air Force. The CRRES satellite contains 5 payloads which include experiments on high efficiency solar cells, ionospheric structure and chemistry, and radiation effects on microelectronic devices. The satellite also contains NASA chemical payload which consists of 24 chemical canisters. These canisters will be ejected from the main spacecraft and release chemicals at specific times during the mission.

Launch Date:	June 1990
Payload:	56 instruments and 24 chemical canisters
Orbit:	400 km by 35,786 km with 18.0 degree inclination
Design Life:	Greater than 1 year
Length:	2.2 m
Weight:	1,724 kg
Diameter:	2.6 m
Launch Vehicle:	ELV (Atlas/Centaur)

Mission Events

Chemical release dates will depend on launch date and initial local time of apogee
End of mission: Launch + 3 years

Management

NASA Headquarters
R. Howard, Program Manager
O. Storey, Program Scientist
Marshall Space Flight Center
J. Stone, Project Manager
D. Reasoner, Project Scientist
Major Contractors
Ball Corporation, Aerospace Systems Division

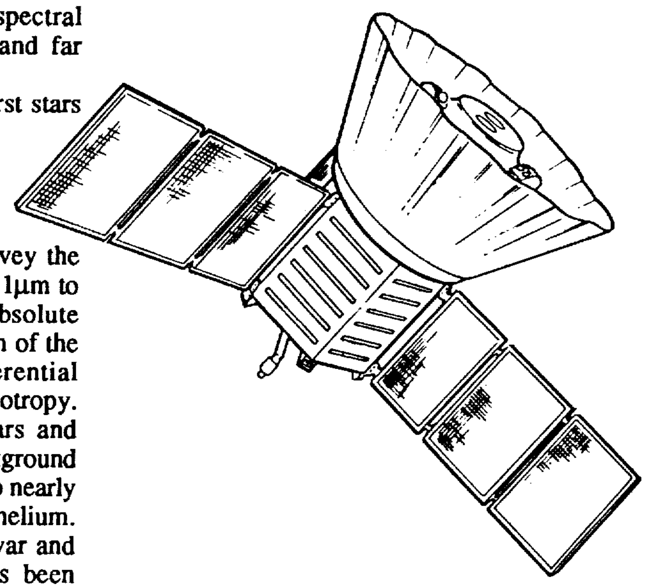
Status

The CRRES spacecraft was originally configured for launch on the Shuttle. The spacecraft has been reconfigured for launch on an Atlas/Centaur and modifications are being completed. The spacecraft will be ready for a June 1990 launch.

COSMIC BACKGROUND EXPLORER (COBE)

Objective

- Investigate the onset of organization of matter into galaxies, voids, and clusters of galaxies following the thundering chaos of the Big Bang thought to mark the creation of the Universe
- Examine departures from perfect uniformity that must have occurred shortly after creation, appearing as spectral irregularities and anisotropy in the microwave and far infrared cosmic background radiation
- Search for the accumulated light from the very first stars and galaxies



Description

COBE is a free-flying Explorer mission that will survey the sky for diffuse emission in the wavelength range from 1μm to 1 cm. At long wavelengths, the Far Infrared Absolute Spectrophotometer (FIRAS) will measure the spectrum of the cosmic microwave background while the Differential Microwave Radiometer (DMR) will measure the anisotropy. At shorter wavelengths, the search for the first stars and galaxies will be conducted by the Diffuse Infrared Background Experiment (DIRBE). FIRAS and DIRBE are cooled to nearly absolute zero inside the observatory's dewar of liquid helium. The receivers of DMR are mounted between the dewar and COBE's deployable RF/thermal shield. COBE has been developed "in-house" at the Goddard Space Flight Center with subsystems procured from private industry.

Launch Date:	July 1989
Payload:	3 instruments
Orbit:	900 km altitude, near polar
Design Life:	One year, nominal (dewar coolant lifetime)
Length:	(Stowed/deployed)--4.4/5.4 m
Weight:	2,272 kg
Diameter:	(Stowed/deployed)--2.2/8.4 m
Launch Vehicle:	Delta ELV
Foreign Participation:	None

Mission Events

Deliver instruments to the observatory: October 1988
Complete observatory integration: January 1989
Flight Readiness Review: May 1989
Headquarters Mission Readiness Review: May 1989

COSMIC BACKGROUND EXPLORER (COBE) (Continued)

Management

NASA Headquarters
D. Gilman, Program Manager
F. Gillet, Program Scientist
Goddard Space Flight Center
R. Mattson, Project Manager
D. McCarthy, Deputy Project Manager
J. Mather, Project Scientist
Major Contractors
COBE is an in-house project with GSFC serving the role of the systems contractor.

Status

Redesign of COBE for a Delta launch has been completed. All spacecraft subsystems have been delivered and integration is complete. Observatory testing is underway.

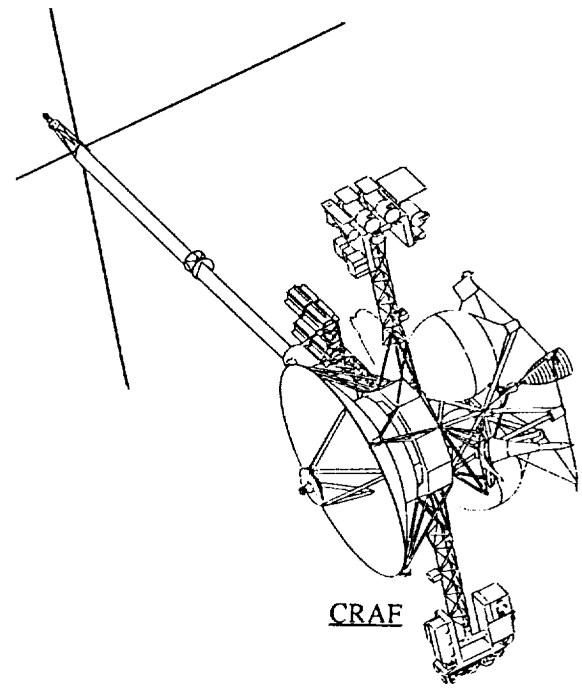
COMET RENDEZVOUS ASTEROID FLYBY (CRAF)/CASSINI

Objectives

The CRAF/Cassini Program, building on the discoveries made the Pioneers and Voyagers spacecraft, will provide unprecedented information on the origin and evolution of our solar system and will help tell how the necessary building blocks for the chemical evolution of life are formed elsewhere in the universe.

CRAF

- Determine composition and character of cometary nucleus; characterize changes that occur as functions of time and orbital position
- Characterize cometary atmosphere and ionosphere; characterize development of coma as a function of time and orbital position
- Determine comet tail formation processes; characterize interaction of comets with solar wind and radiation
- Characterize physical and geological structure of asteroid
- Determine major mineralogical phases and distribution on surface of asteroid



CRAF

Cassini

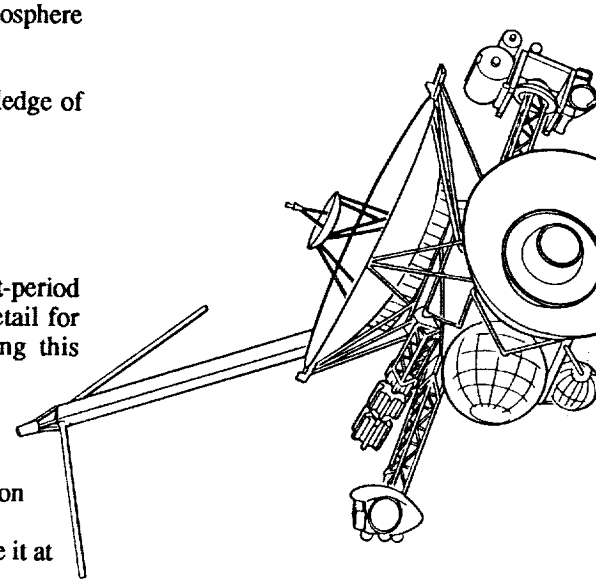
- Conduct a detailed exploration of the Saturnian System including:
  - Study of Saturn's atmosphere, rings, and magnetosphere
  - Remote and in situ study of Titan
  - Study of Saturn's icy moons
- Flyby an asteroid and Jupiter to expand our knowledge of these bodies

Description

CRAF

This free-flying mission will rendezvous with the short-period comet Kopff near aphelion and study the comet in detail for over 3 years, continuing through perihelion. During this time, the mission will:

- image the entire comet nucleus at high resolution
- determine its chemical, isotopic, and mineral composition
- observe the evolution of the coma and its interaction with the solar wind and magnetic field
- collect dust boiled off from the comet and examine it at high power with an electron microscope
- send a penatrator into the comet nucleus to take a direct sample and analyze its composition.



Cassini

After launch in 1995, the CRAF spacecraft will use a combination of deep-space maneuvers (Delta-V) and Earth gravity assist to gain additional energy. CRAF will fly past the asteroid Hamburga (C type, radius 44 km) in 1998 making detailed observations, and will arrive at the comet Kopff in the year 2000. The spacecraft will remain in its vicinity through perihelion passage in 2002. After an initial characterization phase, and instrumented penetrator will be deployed into the comet nucleus for in-situ material analyses.

COMET RENDEZVOUS ASTEROID FLYBY (CRAF)/CASSINI (Continued)

Description (continued)

CRAF (continued)

Following perihelion, the spacecraft will make a long excursion down the comet's tail and then return to the nucleus. Nominal mission end is 3 months after the perihelion.

Launch Date:	1995 (assuming a FY 1990 new start)
Payload:	13 instruments
Orbit:	Interplanetary--Delta-V/Earth Gravity Assist, Comet Rendezvous
Design Life:	12 years
Weight:	1,600 kg
Launch Vehicle:	Titan IV/Centaur
Foreign Participation:	Federal Republic of Germany (Propulsion Subsystem and one science instrument), 20 European Co-Investigators

Cassini

This free-flying mission will spend 4 years in orbit around the planet Saturn conducting a detailed exploration of the Saturnian system. At the conclusion of this mission, we will have a better understanding of:

- The origin and evolution of the solar system
  - Elemental and isotopic abundances
  - The internal structure of Saturn, Titan, and icy satellites
  - The surface morphology of Titan, icy satellites, and asteroids
  - Structure, dynamics and evolution of Saturn's rings
- Chemical evolution in the solar system
  - Surface state and atmospheric chemistry of Titan
  - Composition of dark material on Iapetus, Phoebe, and asteroids
- Processes in Cosmic Plasma Physics
  - Interaction of flowing plasma with icy solid bodies
  - Plasma impact processing of surfaces and atmospheres
  - Interaction of energetic plasma, gas and dust

After launch in 1996, the Cassini spacecraft will use a combination of deep-space maneuvers (Delta-V) and both Earth and Jupiter gravity assists to gain energy. Cassini will fly past the asteroid 66 Maja (C type, radius 30 km) in 1997 and the planet Jupiter in 2000, making detailed observations at each close approach. The spacecraft will arrive at Saturn in the year 2002 and will be inserted into a loose elliptical orbit. The Titan probe will be dropped into the atmosphere of Titan during the first orbit. The Cassini orbiter will then make approximately 40 revolutions to study Saturn, its rings, satellites, and magnetosphere.

Launch Date:	1996 (assuming a FY 1990 new start)
Payload:	15 instruments on orbiter 10 instruments on probe
Orbit:	Interplanetary-Delta-V/Earth/Jupiter Gravity Assist, Saturn orbit
Design Life:	12 years
Weight:	1,804 kg
Launch Vehicle:	Titan IV/Centaur
Foreign Participation:	European Space Agency (Cassini Titan Probe and TBD instruments on the Orbiter and Probe), Federal Republic of Germany (Propulsion Subsystem), TBD European Co-Investigators

COMET RENDEZVOUS ASTEROID FLYBY (CRAF)/CASSINI (Continued)

Mission Events

CRAF
Deep Space Maneuver #1: July 1996
Earth Flyby: July 1997
Asteroid Flyby: January 1998
Deep Space Maneuver #2: April 1998
Arrival at Comet: August 2000
Penetrator Deployment/Relay: 2001
Comet Perihelion: December 2002
Nominal End-of-Mission: March 2003

Cassini
Deep-Space Maneuver #1: February 1997
Asteroid Flyby: March 1997
Deep Space Maneuver #2: January 1998
Earth Flyby: June 1998
Jupiter Flyby: February 2000
Saturn Arrival: October 2002
Probe Deployment: January 2003
Nominal End of Mission: October 2006

Management

NASA Headquarters
D. McConnell, Program Manager
H. Brinton, Program Scientist
Jet Propulsion Laboratory
R. Draper, Project Manager
M. Neugebauer, Project Scientist
D. Matson, Project Scientist (Cassini)
ESA Headquarters (Cassini)
M. Coradini, Program Manager
ESTEC (Cassini)
G. Scoon, Project Manager
J-P. LeBreton, Project Scientist
Major Contractors
Martin Marietta Denver Aerospace (Titan IV launch vehicle)
General Dynamics Corporation (Centaur upper stage)
Ball Aerospace Systems Division, Boulder, CO (penetrator system--subcontracted through the University of Arizona)(CRAF)

Status

CRAF Phase A mission studies have been completed; Phase B technical definition study is well along, as are advanced technology developments for the mission. A payload of 13 instruments was selected in 1986; the Science Working Group is continuing to define science objectives and to work with the project on the spacecraft and mission design. Messerschmitt-Boelkow-Blohm (MBB) is working with JPL on the design for the propulsion subsystem.

COMET RENDEZVOUS ASTEROID FLYBY (CRAF)/CASSINI (Continued)

Status (continued)

The CRAF mission has been evaluated four times by a Non-Advocate Review Board, most recently in July 1988, and has been strongly recommended for a FY 1990 new start with the Cassini mission. The missions have also been strongly endorsed by the Space and Earth Sciences Advisory Commission (SESAC), the NAS Committee on Lunar and Planetary Exploration (COMPLEX), and the Life Sciences Division.

The Cassini mission was combined with the CRAF mission in February 1988 to form a single initiative within the Mariner Mark II Program. As a result the orbiter segment of Cassini inherited a great deal of Phase A, Phase B and Advanced Technology Development work from CRAF. The Titan entry probe has completed a Phase A study by ESA with Marconi Space Systems as the prime contractor and in November 1988 was selected by ESA as its major new science program.

Separate but coordinated Announcements of Opportunity for the science payload will be released by NASA (orbiter) and ESA (probe) in October 1989. Payload selection for Cassini will be announced in October 1990.

COSMOS

Objective

- Investigate the areas of rodent and primate physiology, general biology, and radiation biology and dosimetry
- Identify the physiological, developmental, biochemical, and behavioral changes associated with microgravity
- Identify and evaluate potential hazards during long-duration space flight

Description

COSMOS is a joint U.S-U.S.S.R. program including U.S. investigators that conduct scientific investigations aboard unmanned Soviet Biological Satellite Missions. Since the biosatellite program began over 13 years ago, the U.S. has participated on six missions, and flown experiments involving plants, insects, rodents, fish, and rhesus monkeys.

Launch Date:	July 1989
Payload:	Will include 10 rats, 2 rhesus monkeys and a radiation dosimetry experiment
Orbit: (Projected)	390-424 km apogee, 220-225 km perigee, 62.8 degrees inclination

Mission Events

Flight hardware to U.S.S.R.: March 1989
Launch Date: June 1989

Management

NASA Headquarters
L. Chambers, Program Manager
F. Sulzman, Program Scientist
Ames Research Center
J. Connolly, Project Manager
R. Ballard, Project Scientist

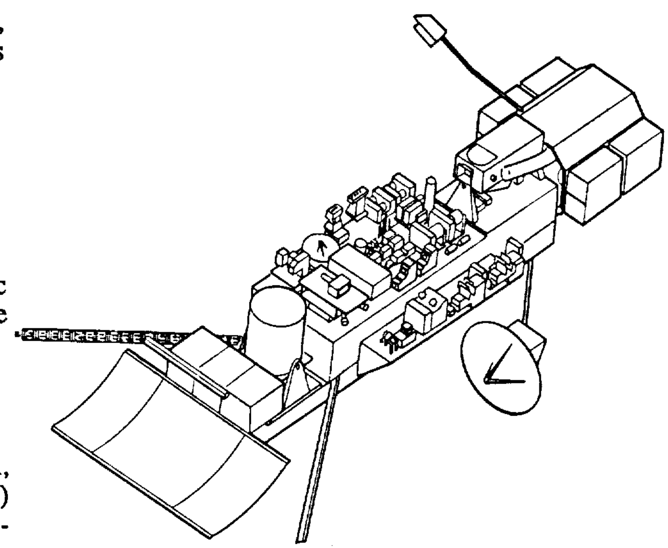
Status

Selection of experiments has been made and preparations are underway for flights in summer 1989 and 1991.

EARTH OBSERVING SYSTEM (Eos)

Objective

Provide long-term (10-year) data sets for Earth system science, including study of the evolution and interaction of the various components:



- agriculture
- forestry
- hydrology
- oceanography
- snow and ice
- atmospheric chemistry
- atmospheric dynamics
- geology

To attain an eventual understanding of the global hydrologic cycle, the global biogeochemical cycle, and the global climate processes.

Description

Eos will consist of four platforms (two provided by NASA, one by the European Space Agency, and one by Japan) containing a variety of instruments to carry out interdisciplinary Earth science studies.

Launch Date:	Last Quarter, 1996 (first NASA platform) Last Quarter, 1998 (second NASA platform) (assuming a FY 1991 new start)
Orbit:	Sun-synchronous, polar, 705 km altitude
Design Life:	10-15 years
Length:	12 m
Weight:	~ 12,425 kg control weight (Titan) ~ 3,500 kg payload weight
Diameter:	4.2 m
Launch Vehicle:	Expendable Launch Vehicle: Titan IV
Foreign Participation:	European Space Agency (ESA) and Japan

Mission Events

Phase A: June 1983-October 1987
Announcement of Opportunity: January 1988-March 1989
Awards: June 1989
Phase B: October 1987-September 1991

Management

NASA Headquarters
A. Tuyahov, Program Manager
D. Butler, Program Scientist
Goddard Space Flight Center
C. McKenzie, Project Manager
G. Soffen, Project Scientist
Major Contractors
TBD

Status

Proposed FY 1991 new start

EARTH PROBES

Objective

The purpose of this mission is to fly a series of Explorer class satellites for Earth observation.

Description

There are currently three candidate payloads for this series:

A. A satellite to measure atmospheric composition by use of the Total Ozone Mapping Spectrometer (TOMS)

b. A satellite to measure rainfall in the tropics for use in understanding weather, climate, and hydrological dynamic processes. It will have a payload composed of a subset of instruments proposed as the Tropical Rainfall Measurement Mission (TRMM). These instruments are the Advanced Very High Resolution Radiometer (AVHRR), a scanning imaging radiometer to measure cloud properties, land vegetation, land snow/ice, and sea surface temperature, the Precipitation Radar (PR), to measure precipitation, and the Special Sensor Microwave Imager (SSM/I), a scanning microwave sounder and surface imager to measure atmospheric composition, ocean ice, ocean surface winds, precipitation, and surface soil moisture. The satellite will have a design lifespan of 3 years, an altitude of 300 km and an inclination of 30 degrees

c. A Magnetic Field Satellite (MAGSAT) to study the Earth's magnetic/gravity fields. MAGSAT has a payload composed of two instruments, the Scalar Magnetometer (SM) , cross coupled arrangement of absorption cells, photodiodes, and amplifiers, and the Vector Magnetometer (VM), which measures and maps magnetic anomalies. The satellite has an on-orbit mass of 181 kg, an altitude of 400 km. an orbital period of 93.1 minutes, and an inclination of 96.8 degrees. The lead center for MAGSAT is Goddard Space Flight Center.

Management

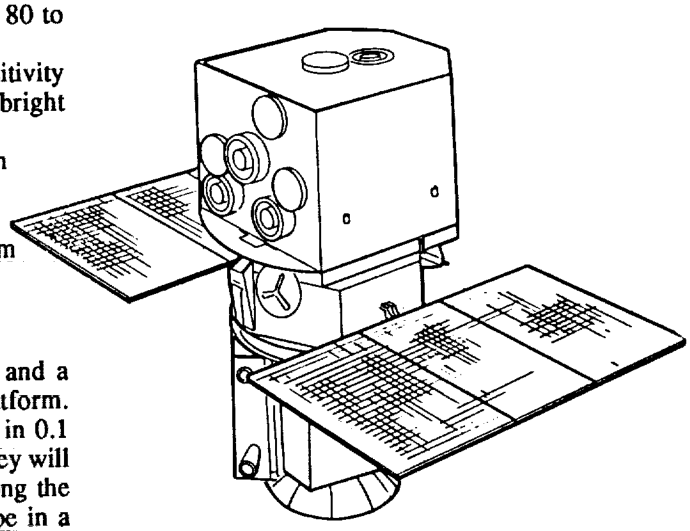
Earth Probes will be managed by NASA Headquarters and the lead centers and contractors for the individual satellites.

Status

Earth Probes is a future concept for small-to-moderate size Earth science missions. Currently the only activity is definition studies.

EXTREME ULTRAVIOLET EXPLORER (EUVE)

Objective



- Produce a highly sensitive survey of the sky in the 80 to 900 angstrom portion of the spectrum
- Survey a portion of the sky with extremely high sensitivity
- Perform follow-up spectroscopic observations on bright EUV point sources
- Study stellar evolution and the local stellar population
- Perform spectral emission physics
- Investigate energy transport in stellar atmospheres
- Study ionization and opacity of the interstellar medium

Description

EUVE consists of four grazing incidence telescopes and a variety of optical filters housed on an Explorer Platform. Approximately 95 percent of the sky will be mapped in 0.1 degrees increments for the all-sky survey. The deep survey will scan a region 2 degrees wide by 180 degrees long along the ecliptic, again in 0.1 degree increments. EUVE will be in a 550 km altitude circular orbit at 28.5 degrees inclination. The mission duration is at least 30 months. At the end of its lifetime this payload will be exchanged for a new one (the X-ray timing explorer, or XTE) via on-orbit servicing. The primary responsibility for this science payload resides with the University of California of Berkeley (UCB).

Launch Date:	August 1991
Payload:	4 instruments
Orbit:	550 km altitude, 28.5 degrees inclination, circular
Design Life:	2.5 years
Length:	2.1 m
Weight:	1,681 kg
Diameter:	3 m
Launch Vehicle:	Delta
Foreign Participation:	None

Mission Events

Mission Preliminary Design Review: June 1988
Mission Critical Design Review: June 1989
Flight Readiness Review: July 1991
Headquarters Mission Readiness Review: July 1991

EXTREME ULTRAVIOLET EXPLORER (EUVE) (Continued)

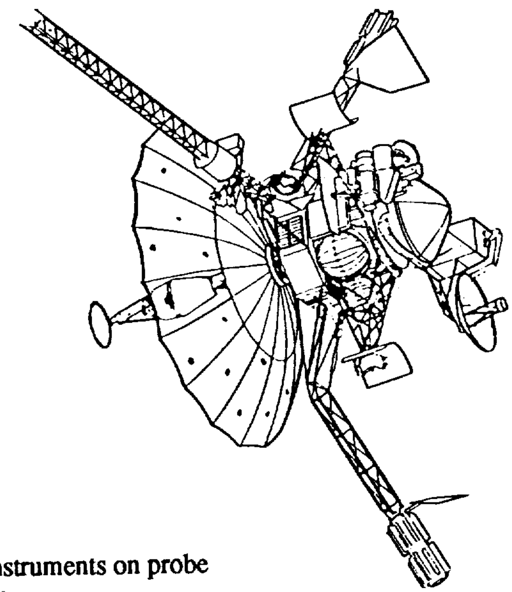
Management

NASA Headquarters
J. Lintott, Program Manager
E. Weiler, Program Scientist
Goddard Space Flight Center
D. Margolies, Project Manager
Y. Kondo, Project Scientist
Major Contractors
Fairchild Space Company
General Electric Company
McDonnell Douglas Astronautics Company

Status

Development of the instrument complement is underway at the University of California at Berkeley. A Multi-Mission Spacecraft bus, with a 10-year lifetime, is being procured by the Goddard Space Flight Center. X-Ray Timing Explorer is in the definition phase.

GALILEO



Objective

- Investigate the chemical composition and physical state of Jupiter's atmosphere and satellites
- Investigate the structure and physical dynamics of Jupiter's magnetosphere

Description

An instrumented probe will enter the Jovian atmosphere and take in-situ measurements for 60 minutes, down to a pressure level of 10 bars, and relay its data to the Orbiter for real-time transmission to Earth. The Orbiter will then be injected into a highly elliptical orbit around Jupiter. The four major Jovian satellites--Io, Europa, Ganymede, and Callisto--will be studied in detail.

Launch Date:	October 1989
Payload:	9 instruments on orbiter and 6 instruments on probe
Orbit:	Dual spin orbiter for stabilization
Design Life:	> 6 years to Jupiter and at least 22 months of study (mission duration) by orbiter-1 hr. of probe data
Length:	9 m
Weight:	2,668 kg
Diameter:	4.8 m (antenna)
Launch Vehicle:	Shuttle/US
Foreign Participation:	Federal Republic of Germany

Mission Events

Venus Flyby: February 1990
Earth Flyby 1: December 1990
Gaspra Encounter: October 1991
Earth Flyby 2: December 1992
Ida Encounter: August 1993
Jupiter Arrival: December 1995
End of Mission: October 1997

Management

NASA Headquarters
R. Murray, Program Manager
W. Quaide, Program Scientist
Jet Propulsion Laboratory
R. Spehalski, Project Manager
T. Johnson, Project Scientist
Ames Research Center
B. Chin
Major Contractors
DFVLR (FRG)
Hughes Aircraft
Messerschmitt-Boelkow-Blohm

Status

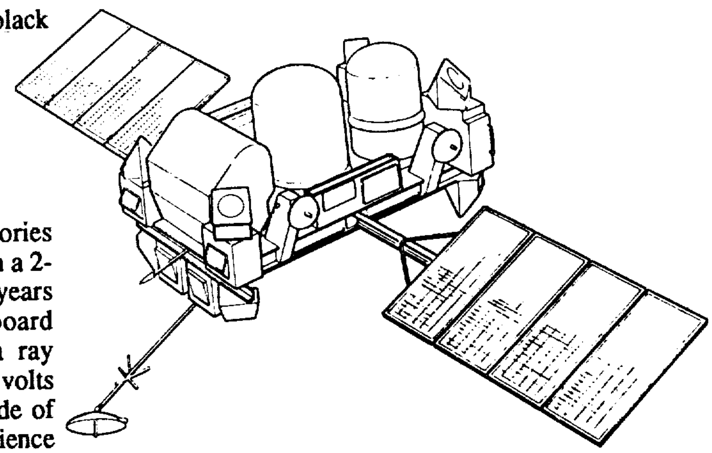
The orbiter is in the final stages of system testing having recently completed integration of the flight subsystems and the crucial environmental test program. During environmental tests, the Orbiter demonstrated that it would perform satisfactorily under conditions (higher solar intensities) imposed by the Venus, Earth, Earth Gravity Assist (VEEGA) trajectory which after launch in the Shuttle/Inertial Upper Stage (IUS), directs the spacecraft away from Jupiter and toward the Sun. The probe has completed re-integration of its science instruments and is currently conducting baseline tests of the subsystems in preparation for a March 1989 delivery to JPL where it will be shipped to Kennedy Space Center in May 1989 for an October 1989 launch. The launch window extends from October 9, 1989, through November 24, 1989.

GAMMA RAY OBSERVATORY (GRO)

Objective

Scientific objectives include:

- Study gamma ray emitting objects in our galaxy and beyond
- Investigate evolutionary forces in neutron stars and black holes
- Search for evidence of nucleosynthesis
- Search for primordial black hole emissions



Description

GRO is the gamma ray element of the Great Observatories program. It is a free-flying astrophysical observatory with a 2-year operational lifetime that can be extended to 10 years through occasional altitude reboost with its on-board propulsion modules. GRO will examine the gamma ray wavelength range from 0.05 to 30,000 million electron volts and its 15,400 kg mass will orbit the Earth at an altitude of 450 km with an inclination of 28.5 degrees. It has four science instruments, the oriented scintillation spectrometer experiment (OSSE), the imaging Compton telescope (COMPTEL), the energetic gamma ray experiment (EGRET), and the burst and transient source experiment (BATSE). The COMPTEL instrument has been developed in the Federal Republic of Germany.

Launch Date:	April 1990
Payload:	4 science instruments
Orbit:	450 km (243 n. mi.) altitude, 28.5 degree inclination, circular orbit,
Design Life:	2 years
Length:	7.62 m (stowed)
Weight:	15,900 kg
Diameter:	4.6 m (stowed)
Launch Vehicle:	STS
Foreign Participation:	West Germany, The Netherlands, United Kingdom, European Space Agency

Management

NASA Headquarters
A. Reetz, Program Manager
A. Bunner, Program Scientist
Goddard Space Flight Center
J. Madden, Project Manager
D. Kniffen, Project Scientist
Major Contractors
TRW, Prime Mission Contractor
Fairchild/IBM, Communication and Data Handling Subsystem
McDonnell Douglas Astronautics Company, Power Modules
Ball Aerospace, Star Trackers and OSSE instrument

GAMMA RAY OBSERVATORY (GRO) (Continued)

Status

The four science instruments have been delivered to TRW and installed on the Observatory. Functional testing of the spacecraft subsystems is currently in progress. Environmental testing of the fully assembled spacecraft is scheduled to start in March 1989.

GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES (GOES I-M)

Objective

Continuous environmental observations of cloud cover. Atmospheric temperatures and moisture profiles, plus severe storm warnings and Search and Rescue Operations.

Description

Under a 1973 Basic Agreement between NASA and NOAA, NOAA establishes the observational requirements for both the polar and geostationary weather satellites. Acting as NOAA's agent, NASA procures the spacecraft and instruments required to meet NOAA's objectives, and provides for their launch. NASA also conducts an on-orbit check out before handing the satellites over to NOAA for routine observations. The requirement to replace spacecraft on an as-needed basis is determined by NOAA.

Launch Date:	1990-1997
Orbit:	Geostationary
Design Life:	5 years
Length:	2.6 m
Weight:	980 kg
Diameter:	2.6 m
Launch Vehicle:	ELV (Atlas/Centaur)

Mission Events

S/C PDR: March 1987
S/C CDR: February 1988
GOES-I: July 1990
GOES-J: November 1991
GOES-K: May 1992
GOES-L: January 1996
GOES-M: December 1997

Management

NASA Headquarters
J. Greaves, Program Manager
Goddard Space Flight Center
C. Thienel, Project Manager
Major Contractors
Ford Aerospace Corporation

Status

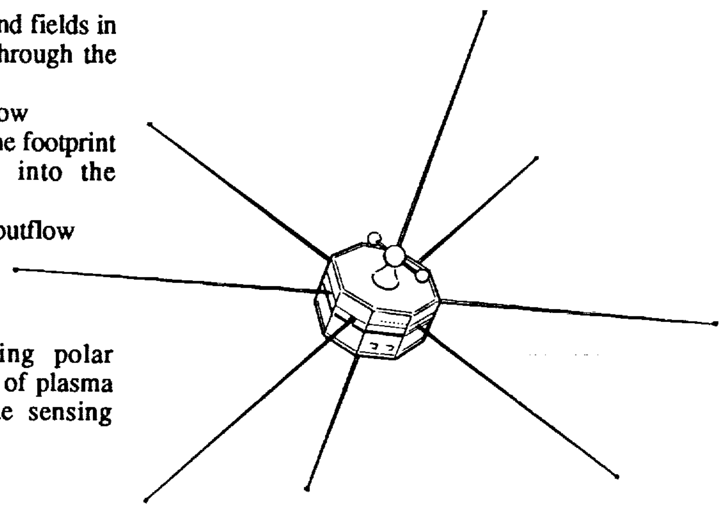
Operational satellite system
Reimbursable program funded by NOAA

GLOBAL GEOSPACE SCIENCE (GGS) PROGRAM--POLAR MISSION

Objective

Characterize the energy input to the ionosphere and:

- Determine the role of the ionosphere in substorm phenomena and in the overall magnetosphere energy balance
- Measure complete plasma, energetic particles, and fields in the high latitude polar regions, energy input through the dayside cusp
- Study characteristics of ionospheric plasma outflow
- Provide global multispectral auroral images of the footprint of the magnetospheric energy disposition into the ionosphere and upper atmosphere
- Determine characteristics of ionospheric plasma outflow



Description

Spin-stabilized NASA spacecraft characterizing polar ionospheric region energy input with a full range of plasma physics fields and particles in situ and remote sensing instrumentation.

Launch Date:	June 1993
Orbit:	2 x 9 Earth radii polar orbit
Design Life:	3 years
Length:	2.0 m
Weight:	1,200 kg
Diameter:	2.8 m
Launch Vehicle:	Medium ELV
Foreign Participation:	Approximately 25 percent of instruments supplied through foreign co-investigators

Mission Events

Instrument PDR: 1989
Spacecraft PDR: 1990

Management

NASA Headquarters
M. Calabrese, Program Manager
G. Parks, Program Scientist
Goddard Space Flight Center
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Major Contractors
GE AstroSpace (East Windsor, NJ)

Status

GE AstroSpace selected as spacecraft mission contractor.
Space contractor understanding effort underway.
Instrument development underway.

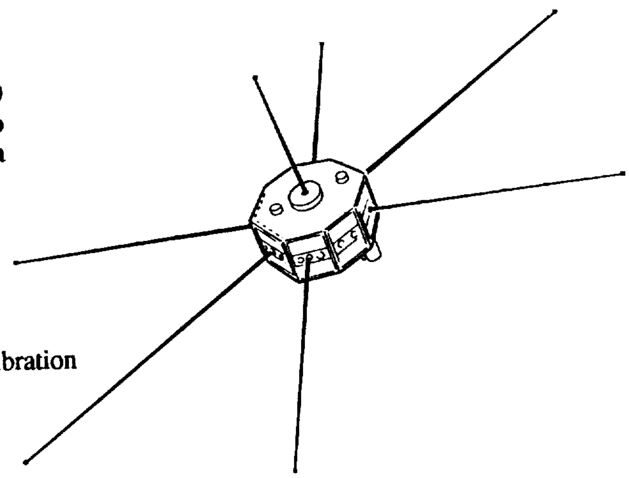
GLOBAL GEOSPACE SCIENCE (GGS) PROGRAM--WIND MISSION

Objective

Determine solar wind input properties including plasma waves, energetic particles, electrics, and electric and magnetic fields for magnetospheric and ionospheric studies in the Global Geospace Science (GGS) Program.

Description

Spin-stabilized NASA spacecraft located at Sun-Earth (L_1) Lagrangian point and dayside double lunar swingby orbits to characterize solar wind input with a full range of plasma physics fields and particles instrumentation.



Launch Date: December 1992
Payload: Instruments
Orbit: Lunar swingby, 250 Earth radii apogee followed by 3×10^5 km radius halo orbit at the L_1 libration
Design Life: 3 years
Length: 2.0 m
Weight: 1,200 kg
Diameter: 2.8 m
Launch Vehicle: Medium ELV
Foreign Participation: Approximately 25 percent of instruments supplied through foreign co-investigators

Mission Events

Instrument PDR: 1989
Spacecraft PDR: 1990

Management

NASA Headquarters
M. Calabrese, Program Manager
G. Parks, Program Scientist
Goddard Space Flight Center:
K. Sizemore, Project Manager
M. Acuna, Project Scientist
Major Contractors:
GE AstroSpace (East Windsor, NJ)

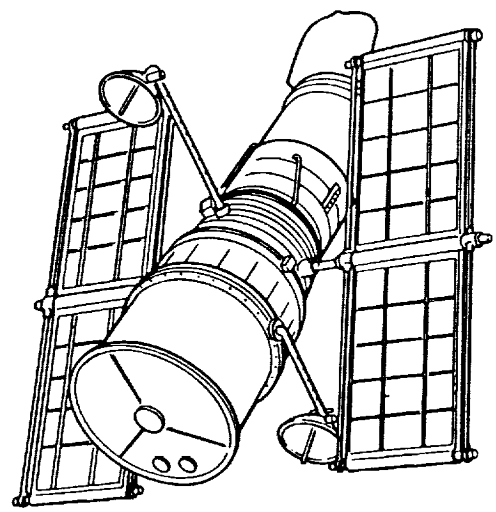
Status

GE AstroSpace selected as spacecraft mission contractor
Space contractor understanding effort underway
Instrument development underway

HUBBLE SPACE TELESCOPE (HST)

Objective

- Investigate the constitution, physical characteristics, and dynamics of celestial bodies
- Determine the nature of processes occurring in stellar and galactic objects
- Study the history and evolution of the universe
- Confirm universality of physical laws



Description

HST is the visible light element of the Great Observatories program, providing coverage of the visible and ultraviolet of the spectrum. It is free-flying observatory with a 15-year operational lifetime achieved through an orbit servicing via the STS or Space Station. The orbited mass of 11,400 kg will fly at a 28.5 degree inclination, 5,300 km circular orbit. HST has a 2.4 meter optical telescope with a cluster of office PI-developed instruments at the focal plane. ESA has provided one instrument plus the solar arrays. HST science instruments are replaceable to achieve state-of-the-art performance. A later payload may include cryogenically cooled detectors in the near infrared.

Launch Date:	December 1989
Payload:	5 instruments
Orbit:	530 km altitude, 28.5 degree inclined orbit, circular
Design Life:	15 years
Length:	13.1 m
Weight:	11,400 kg (25,000 lbs)
Diameter:	4.3 m
Launch Vehicle:	STS
Foreign Participation:	European Space Agency

Mission Events

Ship to Kennedy Space Center: August 1989
Shuttle mission launch and deployment: December 1989
Shuttle mission servicing and potential reboost: 1994 or as necessary

Management

NASA Headquarters
D. Broome, Program Manager
E. Weiler, Program Scientist
Marshall Space Flight Center
F. Wojtalik, Project Manager
Goddard Space Flight Center
J. Moore, Project Manager
Major Contractors
Lockheed Missiles and Space Company
Perkin-Elmer
Space Telescope Science Institute

HUBBLE SPACE TELESCOPE (HST) (Continued)

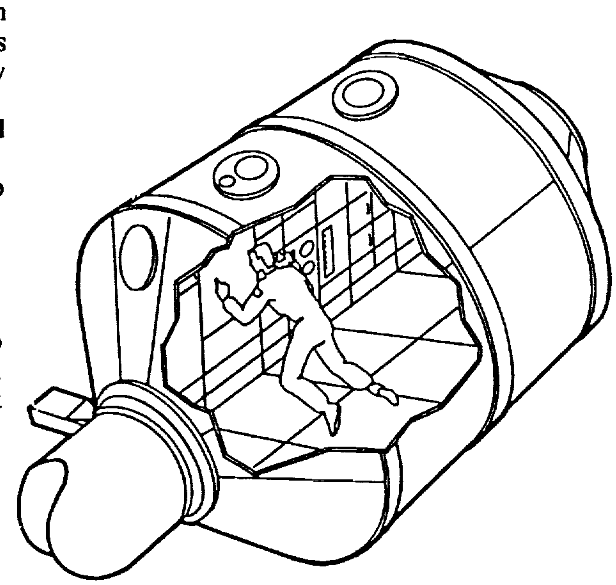
Status

The HST is currently at Lockheed Missiles and Space Co. in Sunnyvale, California, awaiting shipment to KSC in August 1989 for launch in December 1989.

INTERNATIONAL MICROGRAVITY LABORATORY (IML) SERIES

Objective

- Establish a space laboratory program with long-term continuity to conduct high-quality science investigations for disciplines that require access to the microgravity environment of space
- Offer U.S. scientists access to flight hardware developed independently by NASA and other nations
- Give the international scientific community access to Spacelab and its capabilities



Description

The IML series will focus on materials and life sciences, two disciplines needing access to a laboratory in reduced gravity. IML missions will fly at 17- to 25-month intervals so that scientists may build upon results from previous investigations, thus preparing for the Space Station era. NASA will provide the flight opportunities, define and integrate the payload, and maintain responsibility for mission management. IML is derived from a concept whereby multiple application research instruments in complementary fields fly together frequently with minimal disassembly and rework between missions. In many investigations, the payload crew will be actively involved as trained scientists; they will perform experiments on-orbit and provide immediate scientific analysis of experiment progress to investigators on the ground.

Launch Date:	IML-1: February 1991 IML-2: October 1992
Investigations:	14 planned
Orbit:	300 km altitude, 28.5 degree inclination
Duration:	9-10 days
Weight:	Approx. 11,765 kg
Vehicle:	Spacelab/STS
Foreign Participation:	European Space Agency--Biorack and Critical Point Facility, French Centre National d'Etudes Spatiales (CNES)--Mercury-Iodide Crystal Growth, National Research Council of Canada (NRCC)--Space Physiology Experiments, National Space Development Agency (NASDA) of Japan--Organic Crystal Growth Facility, German Aerospace Research Establishment (DLR)--Biostack and Cryostat
Payload Specialists:	2

Mission Events

IML-1:
Mission definition studies: Completed
Mission concept, feasibility studies: Completed
Delta Critical Design Review: June 1989
Flight Readiness Review: January 1991

Mission Events (continued)

IML-2
Preliminary hardware selection: January 1989
Payload Confirmation: December 1989
Preliminary Design Review: June 1990
Critical Design Review: December 1990
Flight Readiness Review: August 1992

Management

NASA Headquarters
S. R. Smith, Program Manager (Flight Systems)
R. White, Program Scientist (Life Sciences)
R. Sokolowski, Program Material Scientist (Materials Sciences)
Marshall Space Flight Center
B. McBrayer, Project Manager
R. Snyder, Project Scientist
Major Contractors
Teledyne Brown

Status

Payload specialist candidates for the IML-1 mission are:
1. Dr. Ulf D. Merbold, ESA--Materials Science Experiments
2. Dr. Roger K. Crouch, NASA--Materials Science Experiments
3. Dr. Roberta L. Bounder, Canada--Life Science Experiments
4. Dr. Kenneth Money, Canada--Life Science Experiments.

The prime and backup payload specialists will be designated for the flight crew in the late 1989 time frame.
IML-1 PIP/ICD Delta Review: February 1-3, 1989.

LASER GEODYNAMICS SATELLITE II (LAGEOS II)

Objective

To make very precise satellite geodetic measurements to enhance research in the following areas:

- Regional crustal deformation and plate tectonics
- Geodetic reference datum and Earth orientation
- Earth and ocean tides
- Temporal variations in the geopotential
- Satellite orbital perturbations

Description

Joint Italian and NASA project using satellite laser ranging. LAGEOS II is a passive satellite dedicated exclusively as a target for accurate laser ranging. It is a spherical satellite with a diameter of 60 cm and weighing 415 kg. The exterior surface is covered by 426 equally spaced laser corner cube retroreflectors.

Launch Date:	August 1991
Orbit:	6,000 km altitude, 109.8 degrees inclination, circular
Design Life:	10,000 years
Launch Vehicle:	STS and the Italian Research Interim Stage (IRIS)
Foreign Participation:	Italian Space Agency (ASI)

Mission Events

Spacecraft Delivery to GSFC: August 1989
Laser/Optical testing of spacecraft: November 1988-February 1989
Research Announcement: February 1988-August 1988
Awards: February 1989
IRIS Delivery: September 1990

Management

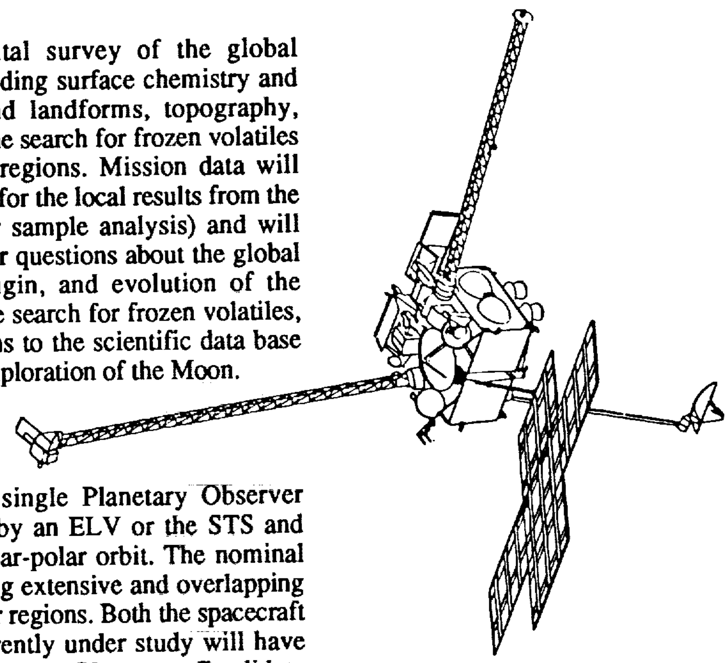
NASA Headquarters
E. Flinn, Program Manager and Program Scientist
Goddard Space Flight Center
G. Ousley, Project Manager
R. Kolenkiewicz, Project Scientist
Italian Space Agency
R. Ibba, Project Manager
University of Bologna
S. Zerbibi, Project Scientist

Status

Laser/Optical testing of the spacecraft is in progress

LUNAR OBSERVER (LO)

Objective



To carry out a long-term orbital survey of the global characteristics of the Moon, including surface chemistry and mineralogy, surface geology and landforms, topography, gravity and magnetic fields, and the search for frozen volatiles in permanently shadowed polar regions. Mission data will provide a global scientific context for the local results from the Apollo Program (including lunar sample analysis) and will also contribute to answering major questions about the global character, internal structure, origin, and evolution of the Moon. The mission, especially the search for frozen volatiles, will also make major contributions to the scientific data base needed to support future human exploration of the Moon.

Description

The mission will consist of a single Planetary Observer spacecraft launched from Earth by an ELV or the STS and placed into a 100-km circular near-polar orbit. The nominal mission will last 1 year, permitting extensive and overlapping coverage, especially near the polar regions. Both the spacecraft and the "strawman" payload currently under study will have extensive inheritance from the Mars Observer. Candidate instruments include: Visual and Infrared Mapping Spectrometer (VIMS), X-Ray/Gamma-Ray Spectrometer (XGRS), Radar (or Laser) Altimeter (ALT), Magnetometer (MAG), Thermal Emission Spectrometer (TES), Imaging System, and Radio Science.

Launch Date:	1990s
Orbit:	100 km circular, near polar
Design Life:	1 year
Length:	TBD
Weight:	TBD
Launch Vehicle:	ELV (or NSTS)

Mission Events

None established. Mission can be initiated about 3-5 days after launch (Earth-Moon travel time).

Management

NASA Headquarters
Solar System Exploration Division
Jet Propulsion Laboratory
Major Contractors
TBD

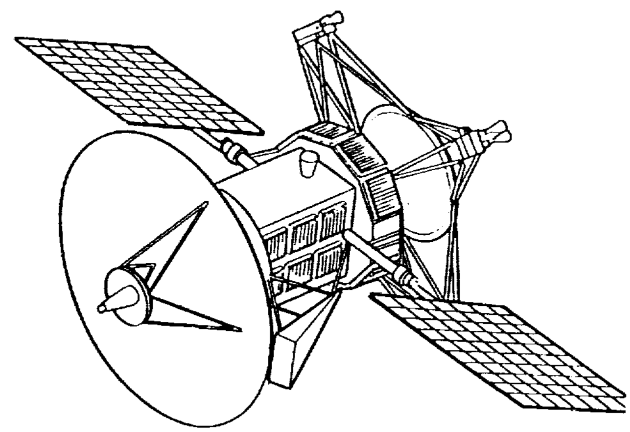
Status

LO is under study as a candidate New Start for the early 1990s. Space instrument and spacecraft components now being obtained for Mars Observer can be applied to LO once they are no longer needed.

MAGELLAN

Objective

- Improve knowledge of the surface tectonics and geologic history of Venus by analyzing the surface morphology and the processes that control it
- Improve knowledge of the geophysics of Venus, principally its density distribution and dynamics
- Improve knowledge of the small-scale physics of the planet
- Obtain global imagery to better than 1 km resolution
- Obtain topography to 50 m resolution



Description

The Magellan spacecraft will be launched in April 1989 by the Shuttle and Inertial Upper Stage on an interplanetary trajectory to Venus. The selected trajectory has a heliocentric transfer angle slightly greater than 540 degrees and requires 15 months of flight time. Upon arrival at Venus in August 1990, the spacecraft will use its solid rocket motor to get into an elliptical near-polar orbit around Venus. During a mapping period of 8 months, the Synthetic Aperture Radar (SAR) will be used to obtain radar images of 70 to 90 percent of the planet, with a resolution about ten times better than that achieved by the Soviets' Venera 15 and 16 missions. Precise radio tracking of the spacecraft will provide gravity information. The resulting geological maps will permit the first global geological analysis of the planet comparable to those that have been done for the other planetary bodies of the inner solar system.

Launch Date:	April 1989
Payload:	1 instrument (Radar Sensor)
Orbit:	Elliptical with 250-km periapsis, 3.15 hr-period, 86 degrees inclination
Design Life:	3 years
Length:	6.4 m with SRM
Weight:	Injected Mass 3,450 kg; on-orbit dry mass 1,035 kg
Diameter:	3.7 m
Launch Vehicle:	Shuttle/2 stage IUS
Foreign Science Participation:	Australia, France, United Kingdom

Mission Events

Venus orbit insertion: August 1990
Start mapping: August 1990
End nominal mapping mission: April 1991

Management

NASA Headquarters
W. Piotrowski, Program Manager
J. Boyce, Program Scientist
Jet Propulsion Laboratory
J. Gerpheide, Project Manager
A. Spear, Deputy Project Manager
R. Saunders, Project Scientist
Major Contractors
Hughes Aircraft Co. (radar sensor)
Martin Marietta (spacecraft development, assembly, and test)

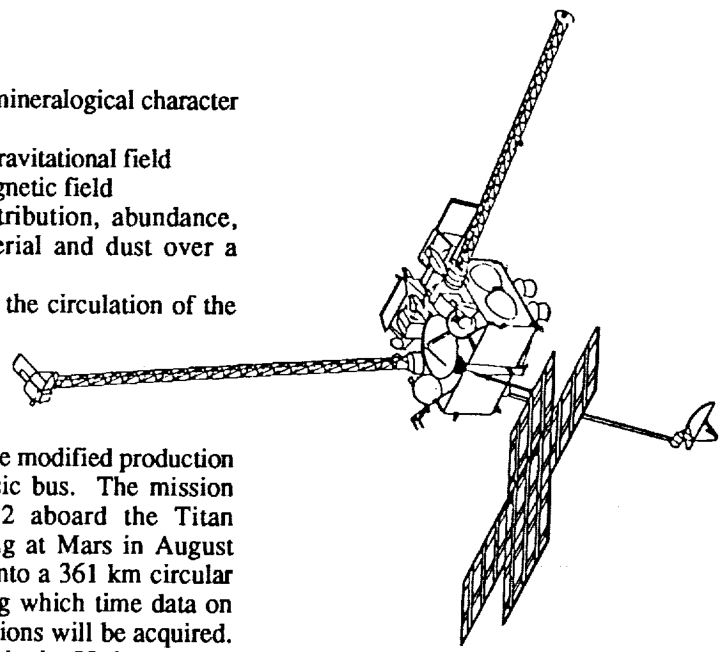
Status

Environmental and functional testing of the radar sensor and spacecraft have been completed and they have been delivered to the launch site, the Kennedy Space Center, for final assembly and testing. The assembled spacecraft is in the final phases of system level testing preparatory to launch. The Magellan spacecraft will be mated with its upper stage, the IUS, in February 1989 and the integrated spacecraft/IUS is scheduled for installation in the Space Shuttle Atlantis in March 1989. Launch is scheduled for April 28, 1989. The launch period extends from April 28 to May 27, 1989.

Development of the ground data system (GDS) is progressing on schedule. Development of the Flight Operations Center (SFOC) is nearing completion and initial GDS/SFOC testing has been successfully accomplished. GDS/SFOC/DSN testing is currently underway. The operational Readiness Review is scheduled for March 1989.

Planning for the Magellan launch phase is underway with elements of the Shuttle and IUS systems. The Final Flight Operations Review has been conducted and planning for the Joint Integrated Launch Simulations is nearing completion. The Flight Readiness Review and the Launch Readiness Review are scheduled for April 1989.

MARS OBSERVER



Objective

- Determine the global elemental and mineralogical character of the surface
- Define globally the topography and gravitational field
- Establish the nature of the global magnetic field
- Determine the time and space distribution, abundance, sources, and sinks of volatile-material and dust over a seasonal cycle
- Explore the structure and aspects of the circulation of the atmosphere

Description

Mars Observer will use a high-inheritance modified production line Earth-orbiter spacecraft as the basic bus. The mission will be launched in September 1992 aboard the Titan III/Transfer Orbit Stage (TOS), arriving at Mars in August 1993. The spacecraft will be inserted into a 361 km circular polar phasing orbit for 2 months, during which time data on both the northern and southern polar regions will be acquired. A plane change will place the spacecraft in the 93 degree sun-synchronous orbit for the remainder of the mission. In 1995, the mission may relay data from the USSR Mars 1994 Atmospheric balloons. At the end of the mission, the orbital altitude will be raised to 525 km to satisfy requirement for biological protection of Mars.

Launch Date:	September 1992
Payload:	7 instruments, 25 individual investigations
Orbit:	Circular, low-altitude (approx. 350 km), near polar (93 degree inclination to equator), sun-synchronous (2 p.m. dayside pass local time)
Design Life:	3 years
Length:	2.2 m
Weight:	1,700 kg (spacecraft dry mass)
Diameter:	16 m
Launch Vehicle:	Titan III/TOS
Foreign Participation:	Austria, Federal Republic of Germany, France, United Kingdom, USSR

Mission Events

Tentative selection of investigations: April 1986
Final confirmation and selection: April 1987
End of Mission: Launch + 3 years
Arrival at Mars: Launch + 1 years

MARS OBSERVER (Continued)

Management

NASA Headquarters
M. Weinreb, Acting Program Manager
B. French, Program Scientist
Jet Propulsion Laboratory
D. Evans, Project Manager
A. Albee, California Institute of Technology, Project Scientist
Major Contractors
GE AstroSpace
Orbital Sciences Corp.

Status

The project baseline is now a 1992 launch from the Titan III, using the Transfer Orbit Stage (TOS) to be supplied by Orbital Sciences Corporation. GE AstroSpace is the spacecraft contractor. Preliminary Design Reviews have been held for the spacecraft and mission system for the instruments.

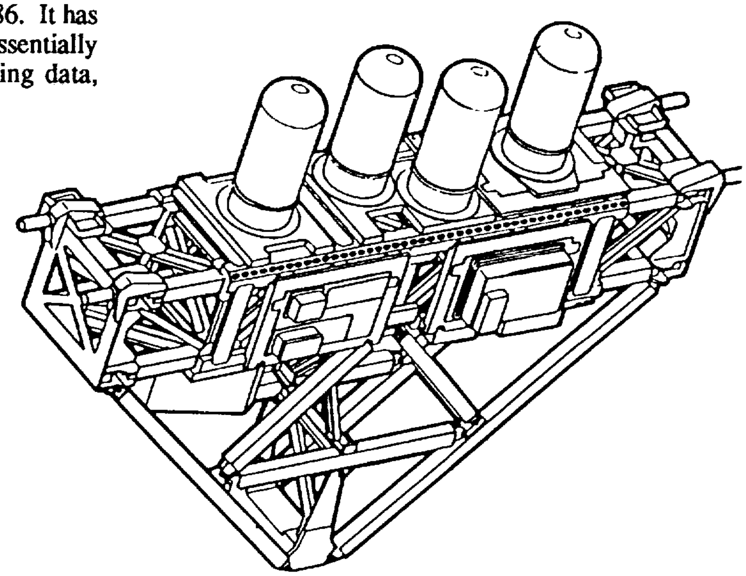
MATERIALS SCIENCE LABORATORY

Objective

To perform materials processing and other experiments in the weightless (microgravity) space environment with inflight monitoring of phenomena, sample production, and postflight analysis of samples. Such activities are expected to advance significantly basic knowledge of materials sciences and to lead to better products and technology for use on the Earth and in space.

Description

The MSL carrier was flown as MSL-2 in January 1986. It has the ability to accept and deliver to the experiments essentially all of resources available from the Orbiter, including data, commands, power, and active thermal control.



Orbit:	No special requirement
Duration:	5 - 7 days
Design Life:	10 Missions
Length:	Approx. 1 meter
Weight:	Approx. 2579 kg
Launch Vehicle:	STS

Mission Events

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Mission implementation: Ongoing
Instrument delivery to KSC: January 1991
Launch readiness date: August 1991

Management

NASA Headquarters
S. Smith, Program Manager (Flight Systems)
W. Hodges, Program Engineer (Microgravity Science and Applications)
Marshall Space Center
R. Valentine, Mission Manager
Major Contractors
TBD

Status

The MSL-3 payload will be the Lambda Point Experiment which will investigate the unique properties of liquid Helium as its temperature is changed though the superfluid region. The analytical engineering activities were begun in January 1989. Follow-on missions using 2 MSL carriers in tandem called the Unites States Microgravity Payload will fly in late 1992. A variety of material science payloads are planned.

MOBILE SATELLITE (MSAT)

Objective

- Create new multi-billion dollar service/hardware industry
- Provide direct two-way voice and data communications for cars, trucks, boats, and planes
- Improve U.S. productivity
- Provide for unique public service needs

Description

A joint NASA-industry program to accelerate the introduction of MSAT service in the U.S. and develop enabling technologies needed to use effectively the spectrum-orbit and ensure future growth. The first generation system will be paid for and built by industry, launched by NASA, and will contain a small amount of channel capacity to carry out government experiments.

Launch Date:	1993
Payload:	Communications
Orbit:	Geostationary, 0 degree inclination
Design Life:	7 years
Length:	TBD
Weight:	TBD
Diameter:	TBD
Launch Vehicle:	ELV
Foreign Participation:	Canada

Mission Events

Develop and field test critical technologies: 1982-1989
Launch offer to industry: 1985
Domestic and international frequencies allocated: 1986-1987
U.S. consortium obtains license: 1989
Commercial satellite launch: 1993
Experiment period: 1993-1995

Management

NASA Headquarters
J. Dickman, Program Manager
Jet Propulsion Laboratory:
W. Rafferty, Project Manager
Major Contractors:
Teledyne Brown
Ball Aerospace
U.S. Consortium (including Hughes, McCaw) is currently filing for license to own and operate commercial system
International
Department of Commerce Canada
Coordination and technical discussions

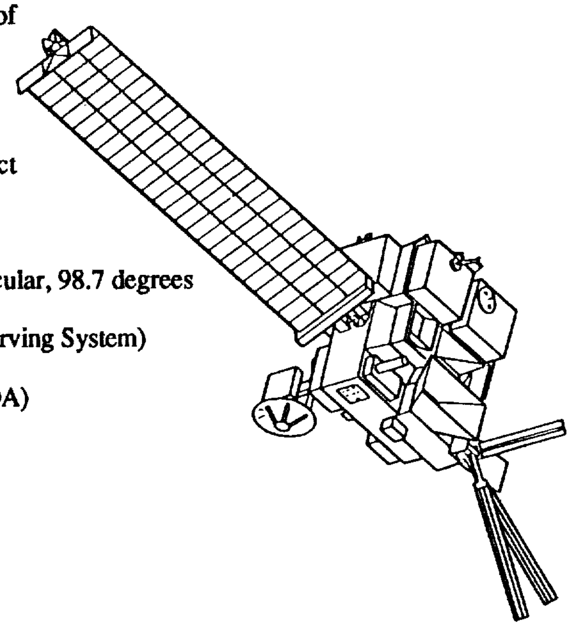
Status

NASA hardware development nearing completion
Field testing scheduled for completion in 1989
U.S. consortium expected to have FCC license approval by mid 1989

NASA SCATTEROMETER (NSCAT)

Objective

Understand the interaction of the atmosphere with the ocean and the relationship to climate change using measurements of ocean surface wind speed and direction.



Description

Joint NASA and Japanese Space Agency (NASDA) project using satellite radar scatterometry.

Launch Date:	February 1995
Orbit:	890 km altitude, nominally circular, 98.7 degrees inclination (sun-synchronous)
Satellite Bus:	ADEOS (Advanced Earth Observing System)
Launch Vehicle:	Japan H-II
Foreign Participation:	Japanese Space Agency (NASDA)

Mission Events

Program start: October 1984
PDR: November 1985
ADEOS Preliminary Selection: January 1989
ADEOS Confirmation August 1989

Management

NASA Headquarters
L. Jones, Program Manager
G. Lagerloef, Program Scientist
Jet Propulsion Laboratory
R. Ruiz, Project Manager
M. Freilich, Project Scientist
Major Contractors
Harris, Watkins-Johnson, Hughes

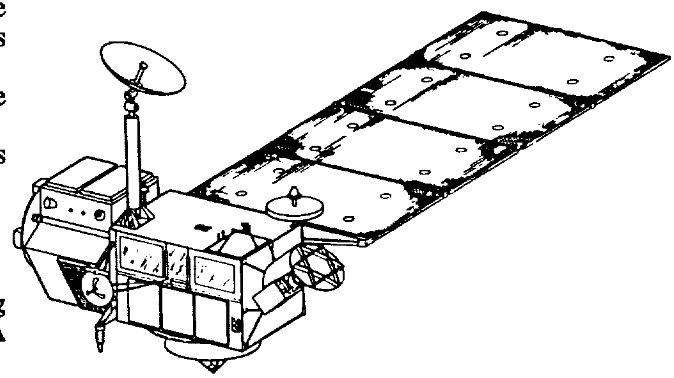
Status

Approved, development in progress
All major contracts in place
Flight antenna fabricated
Science team selected

OCEAN TOPOGRAPHY EXPERIMENT (TOPEX/POSEIDON)

Objective

- Understand the global oceans' general circulation and the relationship to climate change using precise measurements of ocean surface topography
- To increase knowledge of interaction between atmosphere and ocean, including exchange of heat and momentum
- To make detailed maps of currents, eddies and other features of ocean circulation



Description

Joint NASA and French Space agency (CNES) project using satellite radar altimetry, including two French and five NASA instruments.

Launch Date: June 1992
Orbit: 1,334 km altitude, nominally circular, 63.4 degrees inclination
Design Life: 3 years; expendables for 5 years total
Launch Vehicle: Ariane-4
Foreign Participation: French Space Agency (CNES)

Mission Events

Program start: October 1986
Satellite contract award: June 1987
PDR: October 1988
CDR: May 1989
Start sensor integration: July 1990

Management

NASA Headquarters
L. Jones, Program Manager
G. Lagerloef, Program Scientist
Jet Propulsion Laboratory
C. Yamarone, Project Manager
L. Fu, Project Scientist
Major Contractors
Fairchild

Status

Approved development in progress
Contract awarded to Fairchild for satellite development
All instrument contracts in place
Science team selected

POLAR ORBITING ENVIRONMENTAL SATELLITES (POES E-M)

Objective

Global environmental observations of sea surface temperature, snow cover, cloud cover, sea ice, vegetation condition, and atmospheric temperature and moisture profiles, plus Search and Rescue Operations.

Description

Under a 1973 Basic Agreement between NASA and NOAA, NOAA establishes the observational requirements for both the polar and geostationary weather satellites. Acting as NOAA's agent, NASA procures the spacecraft and instruments required to meet NOAA's objectives, and provides for their launch. NASA also conducts an on-orbit check out before handing the satellites over to NOAA for routine observations. The requirement to replace spacecraft on and as-needed basis is determined by NOAA.

Launch Date:	1983-1996
Orbit:	Near-polar, 833-870 km altitude
Design Life:	> 2 years
Length:	4.2 m
Weight:	1,038 kg, (on orbit, EOL)
Diameter:	1.9 m
Launch Vehicle:	Atlas-E through NOAA-J (Titan-II for NOAA-K, L, M)
Foreign Participation:	United Kingdom, France, Canada

Mission Events

NOAA-E: March 1983
NOAA-F: December 1984
NOAA-G: September 1986
NOAA-H: October 1988
NOAA-D: December 1989 (NOAA-D is last of smaller "TIROS-N" spacecraft)
NOAA-I: May 1991
NOAA-J: July 1992
NOAA-K: December 1993
NOAA-L: February 1995
NOAA-M: July 1996

Management

NASA Headquarters
J. Greaves, Program Manager
Goddard Space Flight Center
C. Thienel, Project Manager
Major Contractors
GE AstroSpace
ITT

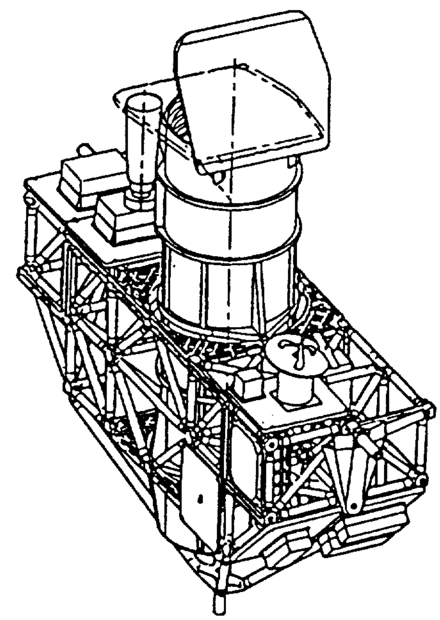
Status

Operational series. Morning (7:30 a.m.) and afternoon (1:30 p.m.) Sun-synchronous orbits. Reimbursable program funded by NOAA.

ORBITING AND RETRIEVABLE FAR AND EXTREME ULTRAVIOLET SPECTROMETER (ORFEUS)

Objective

Spectroscopic investigation of far and extreme UV emission from celestial objects, in the 40 to 120 nm wavelength range, including 1987a supernova remnant.



Description

ORFEUS is a 2 meter ultraviolet telescope assembly carried in the space shuttle payload bay on a German ASTRO-SPAS (Shuttle PAllet Satellite) carrier. ORFEUS is the first in a series of planned ASTRO-SPAS missions. ORFEUS consists of a German EUV telescope and Echelle spectrometer and a United States Rowland spectrometer. The payload operates at a distance of approximately 4 km from the Orbiter after being deployed by the shuttle's remote manipulator system. This ASTRO-SPAS payload is 1.7 meters in length, with on-board battery, cryogenic and N_2 cold-gas maneuvering subsystems. Maximum uplink telemetry data range is 16 kbps. ORFEUS/SPAS is retrieved at the end of the mission and returned to earth with the Orbiter. ORFEUS, together with its co-manifested NASA payload (SHEAL-2), will constitute a joint science mission with a single set of science objectives managed by a single management structure.

Launch Date:	September 1992
Investigations:	1 main instrument
Orbit:	297 km altitude at 28.5 degrees inclination
Duration	7 days
Length:	1.7 m
Weight:	3,500 kg (max)
Launch Vehicle:	STS
Foreign Participation:	Germany (Astronomisches Institut der Universitat Tubingen) supplies ORFEUS. German DLR provides ASTRO-SPAS carrier.

Mission Events

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
ASTRO-SPAS development/fabrication: Ongoing, target completion: September 1990
ORFEUS instrument Phase B design study: Completed
ORFEUS instrument fabrication: Ongoing, target completion: September 1990

Management

NASA Headquarters
L. Demas, NASA/ASTRO-SPAS Lead Program Coordinator
W. Huddleston, ORFEUS Program Coordinator (Flight Systems Division)
R. Stachnik, Program Scientist (Astrophysics Division)
Johnson Space Center
M. Brekke, Payload Integration Manager
Goddard Space Flight Center
F. Volpe, Mission Manager (SHEAL)
F. Marshall, Mission Scientist (SHEAL)

ORBITING AND RETRIEVABLE FAR AND EXTREME ULTRAVIOLET SPECTROMETER (ORFEUS) (Continued)

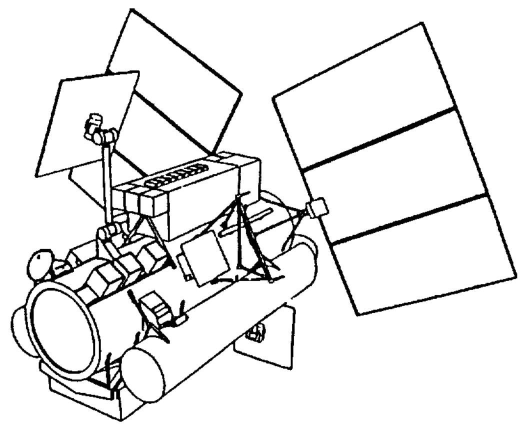
Status

ORFEUS and ASTRO-SPAS hardware is currently in a design/manufacture stage with a September 1990 target instrument delivery date. U.S.-German joint ASTRO-SPAS program memorandum of understanding is in final review, with detailed science letters of agreement for individual missions (including ORFEUS) to be developed in early 1989. The Payload Integration Plan (PIP) draft is under review.

ORBITING SOLAR LABORATORY (OSL)

Objective

To determine the physical structure, chemical composition and dynamics of the solar interior and solar atmosphere. Also, to determine the nature of the physical processes which occur in those parts of the Sun accessible to observations, especially on temporal and spatial scales not previously attainable.



Description

OSL is a three axis stabilized spacecraft which has a meter class telescope and two smaller co-observing telescopes. The meter class telescope is a visible light diffraction limited telescope of conventional Gregorian design. Its focal plane instrument is the Coordinates Instrument Package (CIP) which has a visible spectrograph, tunable filtergraph, and photometric filtergraph. The two smaller telescopes are designed to make measurements in the ultraviolet and soft X-ray spectral regions. OSL will be launched into a sun-synchronous orbit that will provide 9 months of continuous solar observations a year.

Launch Date:	TBD
Orbit:	500 km, 94.7 degree sun-synchronous
Launch Vehicle:	Medium Launch Vehicle
Design Life:	3 years
Length:	4.6 meters
Weight:	3,400 kg
Diameter:	2.8 meters
Foreign Participation:	German cooperative Possible Italy, British cooperative

Mission Events

RFP release for Phase B: April 1989
Award Phase B Contract: October 1989

Management

NASA Headquarters
L. Demas, Program Manager
D. Bohlin, Program Scientist
Goddard Space Flight Center
R. Tatum, Program Manager
D. Spicer, Project Scientist
Major Contractors
Lockheed Palo Alto Research--CIP
Perkin Elmer
TBD for Spacecraft

ORBITING SOLAR LABORATORY (OSL) (Continued)

Status

Phase A completed June 1988
RFP for Phase B plan to be released in April 1989
Two parallel Phase B's to be conducted in FY 1990
Earliest new start date if FY 1991

RADAR SATELLITE (RADARSAT)

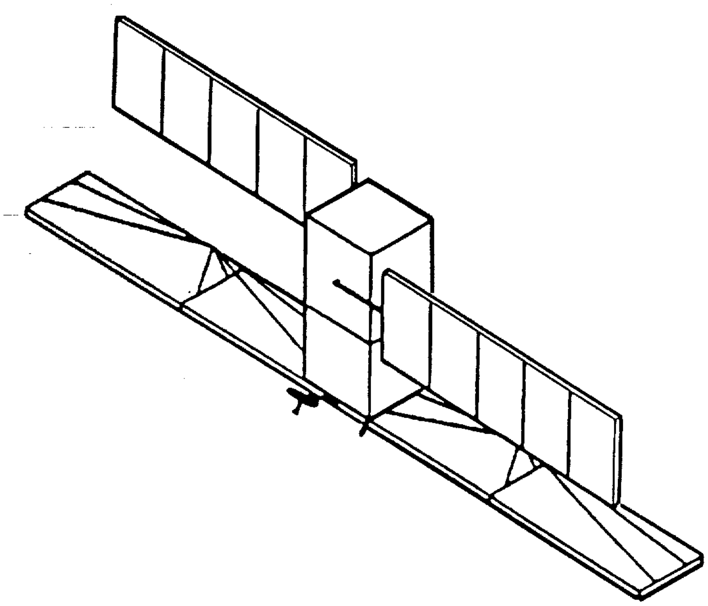
Objective

- To provide detailed information on sea ice and terrestrial ice sheets for climate research.
- To provide radar imagery for geographical applications in oceanography, agriculture, forestry, hydrology and geology.
- To provide real-time products for arctic ocean navigation including ice bag surveillance.

Description

Joint NASA and Canadian Department of Energy, Mines and Resources (DEMR) project using Synthetic Aperture (Imaging) Radar (SAR) technology.

Launch Date:	Mid 1994
Orbit:	800 km altitude nominally circular, 98.6 degrees inclination
Launch Vehicle:	Medium Class
Foreign Participation:	Canada DEMR



Mission Events

Joint US/Canada Study: Since 1979
Program Start: June 1987
Satellite Control RFP: Spring 1989
Start Sensor Integration: Mid 1992

Management

NASA Headquarters
L. Jones, Program Manager
R. Thomas, Program Scientist
Canada DEMR
E. Shaw, Program Manager
Major Contractors
SPAR, S/C -- TBD

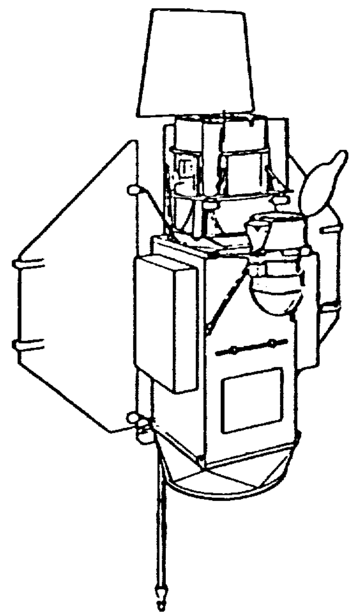
Status

RADARSAT Project approved in June 1987 by Canadian Government
Memorandum of understanding with Canada negotiated but unsigned (June 1988)
Alaska SAR Facility (Earth Receiving Station) Development in progress

ROENTGEN SATELLITE (ROSAT)

Objective

- Study coronal X-ray emission from stars of all spectral types
- Detect and map X-Ray emission from galactic supernova remnants
- Evaluate the overall spatial and source count distributions for various X-ray sources
- Perform detailed study of various populations of active galaxy sources (Seyferts, QSOs, etc)
- Perform morphological study of the X-ray emitting clusters of galaxies
- Perform detailed mapping of the local interstellar medium (by the XUV survey)



Description

ROSAT is an Earth-orbiting X-ray observatory which will fly at a 57 degree inclination and 580 km altitude. It has a fourfold nested grazing incidence mirror system with 83 cm aperture and 240 cm focal length, and covers the wavelength range from 0.1 to 2.0 keV. The ROSAT expected lifetime is approximately 5 years. This mission is a cooperative NASA/United Kingdom/Federal Republic of Germany X-Ray astronomy mission viewed by NASA as a stepping stone toward the Advanced X-Ray Astrophysics Facility (AXAF). Germany is building the spacecraft and main telescope, the United Kingdom a wide field camera, and NASA is providing the High Resolution Imager (HRI) and launch services.

Launch Date:	February 1990
Payload:	4 Instruments
Orbit:	580 km altitude, 57 degree inclination
Design Life:	5 years
Weight:	2,700 kg
Diameter:	3 m
Launch Vehicle:	ELV (Delta-II)
Foreign Participation:	Federal Republic of Germany, United Kingdom

Mission Events

Ground Operations Concept Review completed: September 1987
Design Status Review completed: September 1987
Completion of telescope integration and alignment: August 1989
Pre-ship review: October 1989
Start KSC launch preparations: January 1990

ROENTGEN SATELLITE (ROSAT) (Continued)

Management

NASA Headquarters
N. Rasch, Program Manager
A. Bunner, Program Scientist
Goddard Space Flight Center
G. Ousley, Project Manager
S. Holt, Project Scientist
Major Contractors
Dornier systems

Status

Hardware design, modification, and fabrication for launch on Delta-II (instead of Shuttle) are complete. Flight telescope will be integrated into the flight spacecraft in June 1989. The spacecraft will be shipped to KSC in the fall of 1989 for a February 1990 launch.

REUSABLE REENTRY SATELLITE (LIFESAT)

Objective

To fly life sciences, microgravity, and commercial research payloads at microgravity or artificial gravity environments up to 1.5g for durations up to 60 days.

Description

The RRS is a recoverable satellite which can remain in orbit operating as an unmanned laboratory for up to 60 days. The RRS is configured with a large and readily accessible payload module volume, in which various types of payload modules can be accommodated.

The RRS is approximately 91 cm at the base diameter, 216 cm in height and weighs almost 1,361 kg with the payload. The available payload module volume is 112 cm in diameter and 91 cm in length and can support a payload mass of approximately 240 kg. The RRS vehicle provides utility sources to the payload of electrical energy, thermal control, command signals, and downlink telemetry capability.

It is capable of being launched from a number of different expendable launch vehicles and re-entering independently on ground command. The vehicle is configured to permit the experimenter late access to the payload module prior to launch and rapid recovery post-landing.

The RRS is envisioned to be capable of three flight per year over a 10-year program lifetime. The time between recovery and reflight is 60 days.

Launch Date:	TBD
Investigations:	Plan for life science: effects of radiation, microgravity, artificial gravity on living systems.
Orbit:	Various, depending on experiment requirements
Duration:	Up to 60 Days, 30 days nominal
Launch Vehicle:	DELTA-II, H-II, and possibly others depending on international arrangements
Foreign Participation:	Multinational cooperative science and hardware venture with NRCC, ESA, NASDA, CNES, and DLR

Management

NASA Headquarters
W. Gilbreath, Program Manager
T. Halstead, Program Scientist
P. Blair, Program Support Manager
Johnson Space Center
M. Richardson, Program Manager
Major Contractors
E. Holton, Chairman SWG

Status

Phase B RFP released: 10 January 1989
Studies to begin before 1 July 1989
Letter Agreements in negotiation with foreign partners

SEA-VIEWING, WIDE-FIELD-OF-VIEW-SENSOR (SeaWiFS)

Objective

To provide observations of ocean color for:

- Determination of the mean and variance of global chlorophyll distributions
- Determination of the rate of photosynthetic primary production of the world's oceans.
- Determination of the flux of atmospheric carbon dioxide to the ocean
- Visualization of surface currents
- Determination of the rate of upper ocean heating

Description

SeaWiFS will be flown aboard LANDSAT-6 and consists of instruments to measure radiance in eight parts of the visible spectrum.

Launch Date:	October 1991
Orbit:	Sun-synchronous, 705 km altitude, 98.2 degree inclination
Design Life:	3+ years
Weight:	Payload only 70 kg
Length:	Payload only 15 cm

Mission Events

Program start: January 1989

Management

NASA Headquarters
M. Lewis, Program Manager
Goddard Space Flight Center
R. Kirk, Project Manager
W. Esaias, Project Scientist
Major Contractors
EOSAT Inc.

Status

Pending approval.
Joint EOSAT/NASA working group report complete.
Science Prelaunch Working Group report complete.
Contract in negotiations.

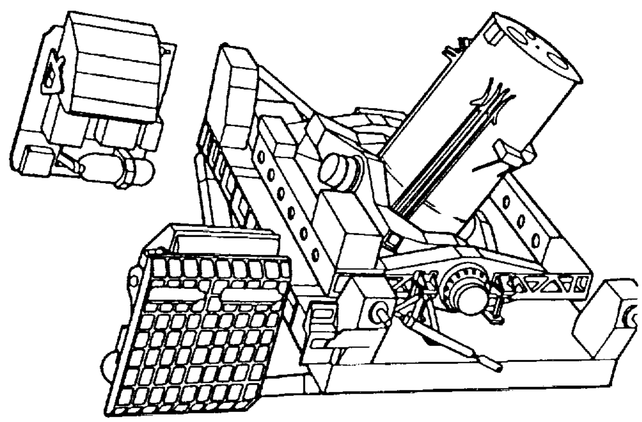
SHUTTLE HIGH ENERGY ASTROPHYSICS LABORATORY (SHEAL-2)

Objective

Obtain images, spectra, and timing data on celestial X-ray sources and the spectrum of the soft X-ray background.

Description

The SHEAL-2 payload consists of two X-ray detecting experiments: the Diffuse X-ray Spectrometer (DXS) and the Broad Band X-ray Telescope (BBXRT). The DXS consists of two identical instruments. Each DXS is mounted on a separate Shuttle Payload of Opportunity Carrier (SPOC) plate and attached to a side of the Shuttle payload bay--one starboard, one port, directly opposite each other. The BBXRT, positioned directly behind the DXS, is held by Two Axis Pointing System (TAPS). This pointing system is attached to a TAPS Support Structure (TSS), which straddles the payload bay. An avionics package is attached to the TSS. This system provides electronics to enable ground controllers and the Shuttle crew to communicate with and command and control the BBXRT and the DXS.



Launch Date: September 1992
Investigations: 2 primary instruments
Orbit: 297 km altitude, 28.5 degree inclination
Duration: 7 days
Weight: 5, 681 kg
Launch Vehicle: STS
Foreign Participation: None

Mission Events

Mission Concept, Feasibility Studies: Completed
Mission Definition Studies: Completed
BBXRT refurb. from ASTRO-1: January 1991
DXS instrument delivery: January 1991
Ship to launch site: September 1991

Management

NASA Headquarters
W. Huddleston, Program Manager (Flight Systems Division)
L. Kaluzienski, Program Scientist (Astrophysics Division)
Goddard Space Flight Center
F. Vlope, Mission Manager
F. Marshall, Mission Scientist
Major Contractors
Space Data Corp. (SDC), Phoenix, AZ

Status

Currently manifested with ASTRO-SPAS/ORFEUS as a single science mission with a single set of science objectives. First SHEAL/ORFEUS planning meeting was held in December 1988.

SMALL-CLASS EXPLORERS (SMEX)

Objective

- Enable new areas of exploration and special topic investigations in space astrophysics, and atmospheric and space plasma physics
- Provide a quick reaction research capability, through modest sized missions and annual launch opportunities, particularly suitable for university or Government research group initiatives and for scientific studies requiring studies particularly fast response (e.g., phenomena such as Supernova 1987 or the Ozone hole)

Description

Small class payloads are modest size (160-227 kg); modest capability payloads, which have made major contributions to most of NASA's space science and applications disciplines, include astrophysics, communications, earth science and applications, space physics, and life science. Recent examples of small class spacecraft include the Astrophysics Division's Small Astronomy Satellite (SAS) series (Uhuru, or SAS-B, obtained the first X-ray full sky survey).

Orbit: TBD
Design Life: TBD
Length: TBD
Weight: 160-227 kg
Launch Vehicle: Small Class

Mission Events

Pending final mission selection, earliest launch dates are:
S1 Launch: 4th Quarter CY 1991
S2 Launch: 4th Quarter CY 1992
S3 Launch: 2nd Quarter CY 1993
S4 Launch: 4th Quarter CY 1993
S5 Launch: 2nd Quarter CY 1994

Management

NASA Headquarters
N. Rasch, Program Manager
Goddard Space Flight Center
R. Adkins, Project Manager
D. Baker, Project Scientist
Major Contractors
TBD

Status

Spacecraft design, and fabrication to begin in early FY 1989. Instrument design and fabrication to begin in the 4th quarter of FY 1989 for a planned CY 1991 launch.

SOLAR PROBE

Objective

- Explore the heliosphere inside of 0.3 AU
- Make in-situ measurements of fields and particles in the very near vicinity of the Sun
- Map the structure of the solar corona
- Determine the mechanism responsible for coronal heating
- Determine the source of solar wind acceleration
- Study transient coronal phenomena such as coronal mass ejections and solar flares

Description

The Solar Probe Mission will feature a single spacecraft designed to make measurements of local fields and particles in the very near vicinity of the Sun. In order to achieve solar orbit, it must be launched towards the planet Jupiter, and Jupiter gravity field must be used to retarget the spacecraft towards the Sun. The goal is to place the spacecraft in an orbit with a perihelion radius of 4 solar radii and an inclination of 90 degrees. The primary encounter phase of the mission will take place while the spacecraft is within the orbit of Mercury ($r < 0.3$ AU) and will last about 10 days. Pole to pole coverage of the Sun will take about 14 hours. It is expected that measurements will be made of the local plasma populations, AC and DC electric and magnetic fields, medium and high energy particles, and neutrons. The spacecraft is also expected to carry EUV/White light and infrared spectrometers.

Launch Date:	May 1998 (assuming a FY 1994 new start)
Orbit:	Interplanetary (Perihelion 4 solar radii, Aphelion 5 AU, Inclination 90 degrees
Design Life:	4 years
Length:	TBD
Weight:	TBD
Vehicle:	Titan-4/Centaur
Foreign Participation:	TBD

Mission Events

Jupiter Flyby: September 1999
Perihelion Passage: June 2001

Management

NASA Headquarters
Space Physics Division
R. Farquhar, Study Manager
M. Mellott, Study Scientist
Jet Propulsion Laboratory
J. Randolph, Study Manager
B. Tsurutani, Study Scientist
Major Contractors:
TBD

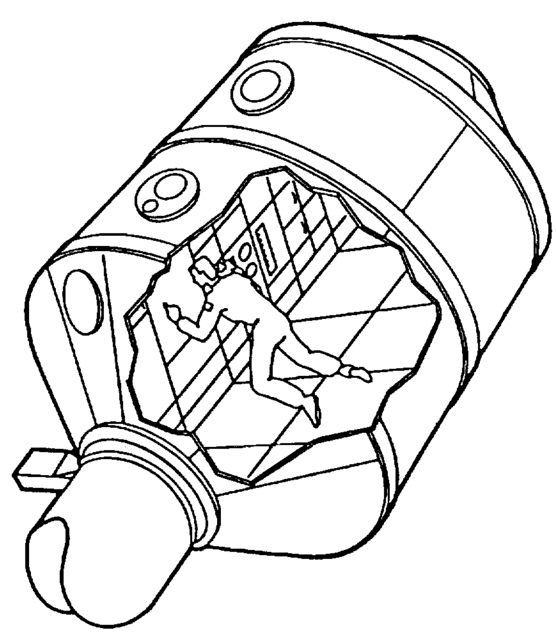
Status

Mission definition study completed
Candidate for a FY 1994 new start

SPACELAB J (S/L-J)

Objective

Conduct basic and applied materials processing research and life sciences investigations that can be conducted only in the microgravity environment of space.



Description

The Spacelab J mission is jointly sponsored by NASA and the National Space Development Agency of Japan (NASDA). NASA will be partially reimbursed for the cost of a dedicated Shuttle flight, including the use of Spacelab systems. The Japanese are providing two Spacelab double racks for the materials science facilities and one double rack for life sciences experiments. The remaining space in the long module will be devoted to NASA materials sciences and life sciences experiments, Spacelab avionics (computers, environmental control, etc.), common support equipment (video recorders, fluid pumps, etc.), and storage space for materials needed for experiments. The crew of seven will include three NASA members, one U.S. payload specialist, and one Japanese payload specialist. Mission and payload operations centers in the United States will support the crew in 24-hour operations.

Launch Date:	July 1991
Investigations:	40 (approximate)
Orbit:	300 km altitude, 44 degree inclination
Duration:	7 days
Vehicle:	Spacelab/STS
Foreign Participation:	NASDA of Japan supplies following equipment: Continuous Heating Furnace, Gradient Heating Furnace, Large Isothermal Furnace, Image Furnace, Acoustic Levitation Furnace, Bubble Behavior Unit, Crystal Growth Experiment Facility, Gas Evaporation Experiment Facility, Liquid Drop Experiment Facility, Marangoni Convection Unit, Organic Crystal Growth Experiment Facility, Aquatic Animal Experiment Unit, Biological Microscope, Cell Culture Kit, Free-Flow Electrophoresis Unit, Light Stimulation Experiment, Protein/Enzyme Crystallization Kit, Thermoelectric Incubator
Payload Specialists:	2

Mission Events

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Instrument delivery to Kennedy Space Center: June 1990
Cargo Integration Review: August 1990

Management

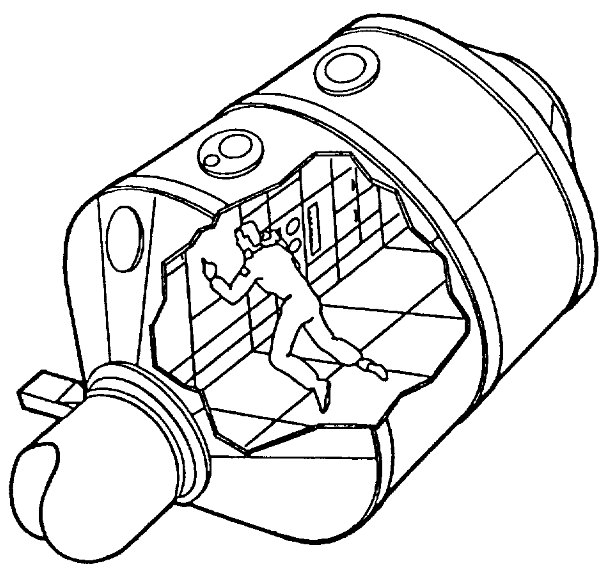
NASA Headquarters
G. McCollum, Program Manager (Flight Systems)
R. Sokolowski, Program Scientist (Microgravity Science and Application)
Marshall Space Flight Center
J. Cremin, Mission Manager
F. Leslie, Mission Scientist
NASDA of Japan
N. Soichi, Program Manager
H. Matsumiya, Program Scientist
Major Contractors:
Teledyne Brown

Status

Mission management has conducted CDR's for the new experiments with experiment developers/PI's from JSC, ARC, LeRC, and MSFC, and is planning to conduct an Integrated Payload C in May 1989. The Japanese have selected three payload specialists for their mission, one will be designated for flight. They are: Dr. T. Doi, Dr. M. Mohri, and Dr. C. Mukai. NASA will select additional payload specialists (either one or two) during 1989. One of these will also be designated for flight.

SPACELAB LIFE SCIENCES (SLS) SERIES

Objective



Dedicated to life sciences research related to the safety, well-being, and productivity of humans in space. A set of coordinated and complementary investigations will focus on observations of early physiological responses to weightlessness that will improve the management of existing problems (e.g., acute fluid shift, cardiovascular adaption and vestibular response including space sickness) and enhance confidence in estimates of the physiological consequences of more sustained weightlessness. Investigations in basic gravitational biology also are to be conducted in the microgravity environment.

Description

The SLS-1 mission is the first Space Shuttle Spacelab Mission dedicated to life sciences research. Proposed by an international team of investigators, 18 primary and 11 secondary inflight payload elements have been selected for flight. The scientific objectives of the mission require data and specimen samples to be gathered from animal and human subjects. In addition to acting as test subjects, the crew will be actively involved in the acquisition and evaluation of data. Life sciences hardware that will undergo initial flight includes the Small Mass Measurement Instrument (SMMI), the Refrigerator/Incubator Module (R/IM), the General Purpose Work Station, (GPWS), the General Purpose Transfer Unit (GPTU), the Physiological Monitoring System (PMS), cardiovascular and cardiopulmonary testing apparatus, and echocardiograph. An updated version of the Research Animal Holding Facility (RAHF) is also manifested and will hold 20 rats.

Launch Date:	SLS-1: June 1990 SLS-2: July 1992 SLS-3: October 1993
Investigations:	30 (approximate)
Orbit:	239 km altitude at 42 degree inclination
Duration:	8 days
Launch Vehicle:	Spacelab/STS
Foreign Participation:	Switzerland
Payload Specialists:	2

Mission Events

SLS-1

Preliminary equipment design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Delta Cargo Integration Review: June 89
Instrument delivery to Kennedy Space Center: June 1989
Launch Readiness Review: May 1990

SPACELAB LIFE SCIENCES (SLS) SERIES (Continued)

Management

NASA Headquarters
G. McCollum, Program Manager, (Flight Systems)
W. Gilbreath, Life Sciences Program Manager (Life Sciences)
R. White, Program Scientist (Life Sciences)
Johnson Space Center
D. Womack, Mission Manager
H. Schneider, Mission Scientist
Major Contractors:
GE Government Services

Status

Delta CDR on SLS-1 was held at JSC (12/88). SMIDEX rack model survey analyses underway at MSFC. The payload specialists for this mission are:

1. Dr. D. Gaffney--selected as a member of the flight crew for SLS-1
2. Dr. R. Phillips--selected as a member of the flight crew for SLS-1
3. Dr. M.H. Fillard--selected as a back-up payload specialist for the SLS-1 mission. Selected to fly as a payload specialist for SLS-2.

SPACE INFRARED TELESCOPE FACILITY (SIRTF)

Objective

- Carry out high sensitivity photometric, imaging and spectroscopic observations of celestial sources in the 2 to 700 μm wavelengths range
- Study cosmic birth formation of galaxies, stars and planets
- Observe new comets and other primitive bodies in the outer solar system
- Study disks of solid material around nearby stars (planetary system development)
- Search for Brown Dwarfs and the missing mass
- Extend IRAS studies of forming stars to earliest phases of star formation
- Identify and study powerful infrared-emitting galaxies at the edge of the Universe
- Provide infrared perspective for the understanding of quasars

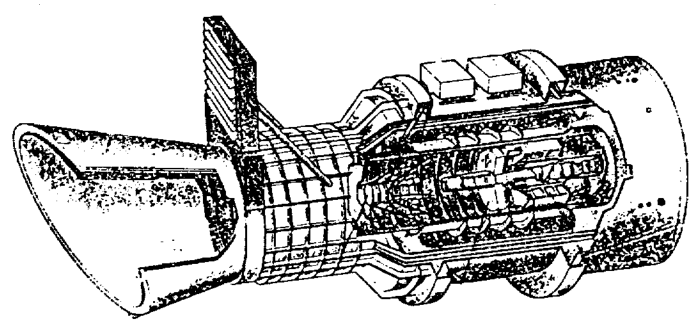
Description

SIRTF is the infrared element of the Great Observatories program. SIRTF is a free-flying observatory including a cryogenically cooled one-meter free-flying observatory with a 5- to 10-year lifetime. It will carry three instruments: an Infrared Spectrometer (IRS), Infrared Array Camera (IRAC), and a Multiband Imaging Photometer (MIPS). A guest observer program will constitute a major fraction of the observing time.

Launch Date:	FY 1998 (assuming a FY 1993 new start)
Payload:	4000L SFHe dewar, 1 meter class cryocooled telescope with 3 focal plane instruments
Orbit:	900 km circular orbit, 28.5 degree inclination (HEO option--70,000 km circular, 28.5 degree inclination)
Design Life:	5 year requirement, 10 year goal with servicing (HEO option--5 years with no servicing)
Length:	Approx. 8.5 m
Weight:	Approx. 7,200 kg
Diameter:	Approx. 3.4 m
Launch Vehicle:	STS (HEO option--Titan IV/Centaur ELV)
Foreign Participation:	None

Mission Events

Orbit option decision: March 1989
Initiation of Phase B study: FY 1991
Initiation of Phase C/D: FY 1993



Management

NASA Headquarters
F. Gillet, Program Manager
L. Manning, Program Manager beginning April 1989
F. Gillet, Program Scientist
Ames Research Center
W. Brooks, Project Manager
M. Werner, Project Scientist

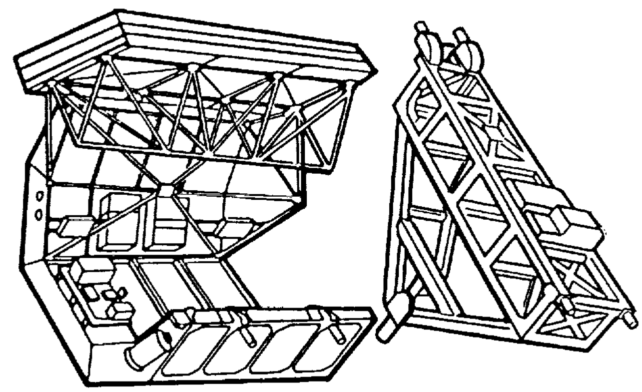
Status

Instrument definition underway
Orbit option study underway--decision in March 1989

SPACE RADAR LABORATORY (SRL)

Objective

- Radar images of the Earth's surface for Earth system sciences studies, including geology, geography, hydrology, oceanography, agronomy, and botany
- Data for future radar systems, designs, including Earth Observing System (Eos)
- Measure global distribution of carbon dioxide in the troposphere



Description

The Space Radar Laboratory carries a modified version of the Shuttle Imaging Radar and the Measurement of Air Pollution from Satellites (MAPS) instruments. The Orbiter orientation will have the open cargo bay facing the Earth. The radar antenna will be unfolded in orbit and used at various viewing angles. The side-looking radar will image a strip parallel to, but offset from, the groundtrack. Five 50-Mbps digital data channels are recorded on special high-rate recorders. Some recorded data and some real-time data will be transmitted to the forward. Preplanned experiment sequences will be initiated by commands issued via the Orbiter's general purpose computer. Two additional flights of this laboratory are planned at 18 month intervals.

Launch Date:	SRL-1: May 1992 SRL-2: February 1993 SRL-3: September 1994
Orbit:	> 222 km altitude at 57 degree inclination
Design Life:	Up to 10 days with reflights
No. of Channels/Frequencies:	2 (L &C band) + 1 (X band)
Spectral Frequency Range:	1.2, 5.3, and 9.8 GHz
Resolution:	10 m
Swath Width:	Depends on mode, 15-70 km
Launch Vehicle:	STS
Foreign Participation:	Italy and West Germany to develop the X-band instrument

Mission Events

SRL-1
Hardware: Under design
Mission PDR: June 1989
Mission CDR: February 1990
Delivery to KSC: January 1991
Launch Readiness Review: April 1992
Launch: 1992

SPACE RADAR LABORATORY (SRL) (Continued)

Management

NASA Headquarters
L. Demas, Program Manager (Flight Systems)
M. Baltuck, Program Scientist (Earth Sciences and Applications)
Johnson Space Center
L. Wade, Mission Manager
D. Amsbury, Mission Scientist
Major Contractors
Ball Aerospace--SIR-C Antenna
Rockwell International--Mission integration

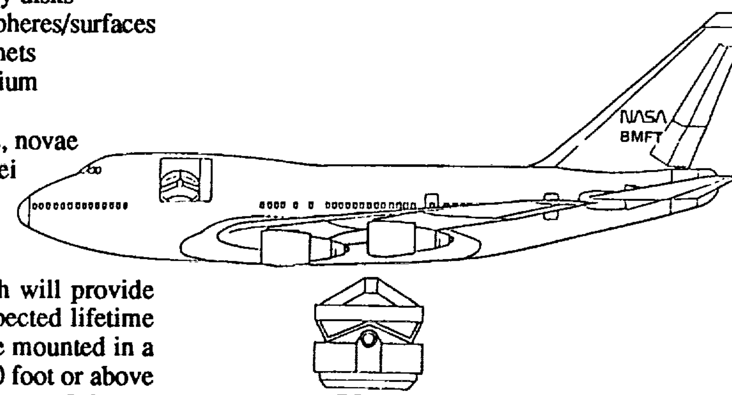
Status

Design of the SIR-C is well under way and the Critical Design Review is scheduled for May 1989. Mission planning and integration activities have been started. A Mission Preliminary Design Review is scheduled for June 1989.

STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY (SOFIA)

Objective

- Structure and composition of the pre-planetary disks
- Composition of planetary and satellite atmospheres/surfaces
- Structure, evolution, and composition of comets
- Physics and chemistry of the interstellar medium
- Star formation and young stellar objects
- Targets of opportunity: occultations, eclipses, novae
- Nature of luminosity sources in galactic nuclei



SOFIA

Description

SOFIA is a unique airborne observatory which will provide capabilities complementary to SIRTF. The expected lifetime is 20 years. The 3 meter-class telescope will be mounted in a 747 aircraft and operated at an altitude of 41,000 foot or above with an evolving complement of roughly 20 state-of-the-art focal plane instruments.

Operational:	FY 1994 (assuming a FY 1991 new start)
Payload:	Up to 20 focal plane instruments in and year
Base Location:	NASA-ARC (nominal); capable or remote deployments for up to 2 months
Design Life:	In excess of 20 years
Length:	Consistent with Boeing 747SP
Weight:	Same
Diameter:	Telescope in 3 meter class
Vehicle:	Boeing 747SP is aircraft of choice
Foreign Participation:	Federal Republic of Germany

Mission Events

Phase C/D initiation: FY 1991
Operational: FY 1994

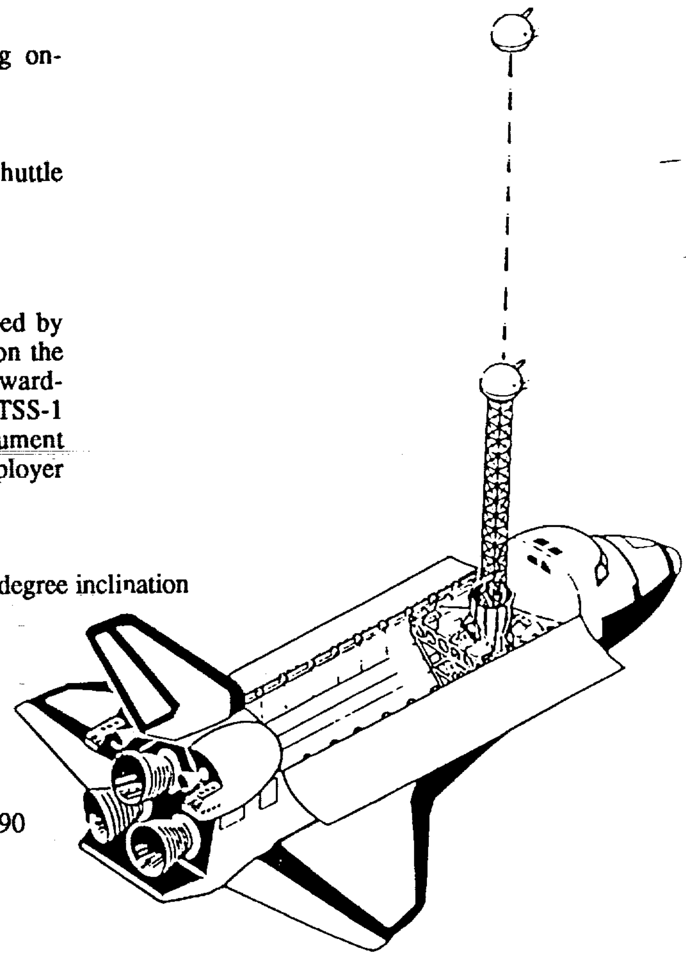
Management

NASA Headquarters
L. Caroff, Program Manager/Scientist
Ames Research Center
G. Thorley, Project Manager
E. Erickson, Project Scientist
Major Contractors
Boeing Military Aircraft
Carl Zeiss (FRG)

Status

Currently in Phase B studies, completion anticipated in June 1989

TETHERED SATELLITE SYSTEM (TSS)



Objective

- Demonstrate capability of deploying, maintaining on-station, and retrieving a tethered satellite.
- Investigate dynamics of tethered systems
- Study the physics of electrodynamic tethers in space
- Investigate interaction between the tether/satellite/Shuttle and the ambient plasma

Description

The TSS is a cooperative space system being developed by NASA and the Italian Space Agency (ASI) for flight on the Shuttle. The first mission, TSS-1, will be the upward-deployment of a satellite on a 20 km conductive tether. TSS-1 consists of a deployer, a satellite with 4 science instrument packages, and 4 science experiments mounted on a deployer pallet.

Launch Date:	January 1991
Orbit:	297 km altitude with 28.5 degree inclination
Duration:	36 hours
Satellite Diameter:	1.6 m
Launch Vehicle:	STS
Foreign Participation:	Italy

Mission Events

Instrument delivery to Kennedy Space Center: March 1990
Deployer delivery to Kennedy Space Center: April 1990

Management

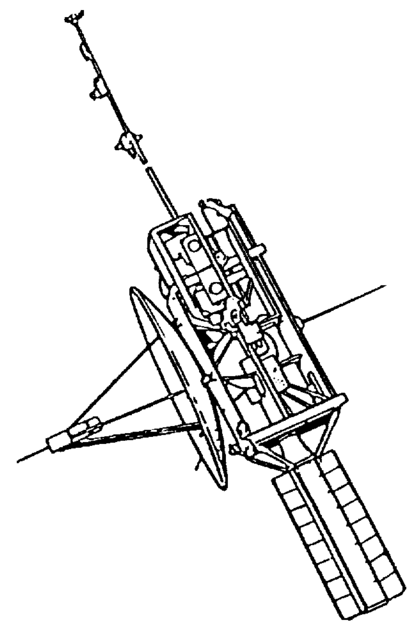
NASA Headquarters
T. Stuart, Program Manager
R. Howard, Program Manager, Science Instruments
O. Story, Program Scientist
Italian Space Agency (ASI)/National Research Council (CNR)
G. Manarini, Program Manager,
F. Mariani, Program Scientist
M. Dobrowoly, Project Scientist
Marshall Space Flight Center
J. Price, Project Manager
N. Stone, Project Scientist
Major Contractors
Martin Marietta

Status

The Integrated Payload (IPL) Preliminary Design Review (PDR) has been completed. The U.S. science instruments have started CDR process.

ULYSSES

Objective



To perform investigations as a functions of solar latitude of the following:

- The physics of the inner and outer corona of the sun
- The origin and acceleration of the solar wind
- The internal dynamics of the solar wind, shock waves, and other discontinuities
- The propagation, composition, and acceleration of energetic particles
- The energy spectra, composition, isotopies and anisotopies of the heliosphere
- Source locations of interstellar gamma rays

Description

Ulysses, formerly known as the International Solar Polar Mission (ISPM), will be launched into a trajectory to intercept Jupiter and use its gravity well to leave the plane of ecliptic and achieve high latitudes (about 70 degrees) relative to the Sun. The European Space Agency (ESA) will provide the spacecraft, five of nine instruments, and is responsible for instrument integration. The United States will provide the launch vehicle, RTG power source, four science instruments, and mission operations facilities.

Launch Date:	October 1990
Payload:	9 instruments
Investigations:	40
Orbit:	Heliocentric 5AU x 1.3 AU
Design Life:	5 years (mission duration)
Length:	2.2 m
Weight:	365.9 kg
Diameter:	4.1 m (including booms)
Launch Vehicle:	Shuttle/Inertial Upper Stage (IUS)/PAM-S
Foreign Participation:	European Space Agency (ESA)

Mission Events

Jupiter encounter for gravity assist to leave plane of ecliptic and achieve high latitude relative to Sun: February 1992
First polar pass of the Sun: August 1994
Second polar pass of the Sun: June 1995
End of Mission: September 1995

ULYSSES (Continued)

Management

NASA Headquarters
R. Murray, Program Manager
J. Bohlin, Program Scientist
Jet Propulsion Laboratory
W. Meeks, Project Manager
E. Smith, Project Scientist
European Space Agency (ESA)
D. Eaton, Project Manager
Major Contractors
Dornier, Federal Republic of Germany

Status

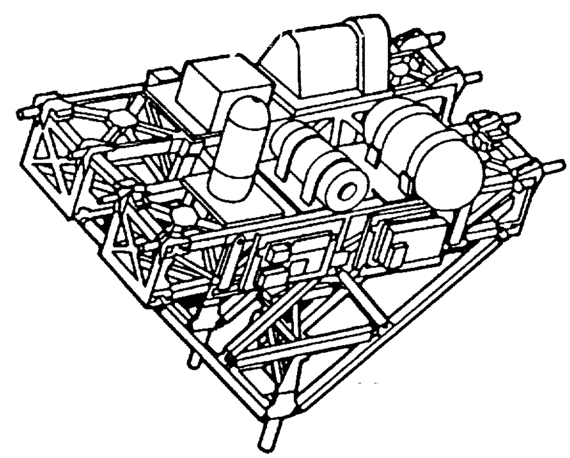
Ulysses was ready for a May 1986 launch on the Shuttle/Centaur. As with Galileo, the combination of the Challenger accident and the Centaur cancellation has forced a mission reevaluation. However, because of Ulysses' smaller mass, a way has been found to maintain the same transit time to higher latitudes of the Sun as that provided by the 1986 launch opportunity. Ulysses will be launched in October 1990 using the Shuttle/Inertial Upper Stage system with an energy augmentation by the PAM-S stage. With this energy augmentation, the spacecraft will arrive at Jupiter with sufficient energy to use the massive Jovian gravity to reach the higher latitudes of the Sun.

The Ulysses spacecraft, which has been in storage at the ESA contractor's facility will be removed in April 1989 to begin a set of comprehensive integration and environmental tests. The successful completion of these tests will reaffirm the flight readiness of the spacecraft. The complement of science instruments have completed retrofit of their memories with improved memory chips. Most instruments are in the final stage of test and calibration in preparation for their re-integration into the spacecraft. Ulysses will be shipped to Kennedy Space Center (KSC) in February 1990 for an October 1990 launch.

UNITED STATES MICROGRAVITY LABORATORY (USML)

Objective

To establish a space laboratory program with long-term continuity to focus on U.S. microgravity materials processing technology, science, and research requiring the low gravity environment of Earth orbit. To emphasize (within the United States) government, commercial, and academic participation in the development of Space Station applications. To offer the U.S. scientific and commercial communities access to Spacclab and its capabilities to develop a science and technology base for Space Station applications.



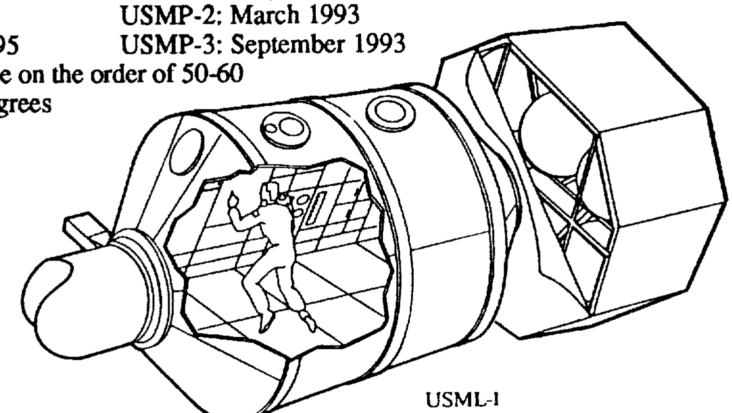
USMP Configuration (Typical)

Description

The United States Microgravity Laboratory (USML) series will focus on materials sciences and applications experiments, as well as technology development. USML missions will fly at 18- to 24-month intervals in order that scientists may build upon results from previous investigations. The payload crew will be actively involved in many investigations as trained scientists performing experiments on orbit and providing immediate scientific analysis of experiment progress to investigators on the ground. The essential low-gravity environment is maintained with a minimum number of thruster firings by using a gravity-gradient stabilized orientation with the Orbiter's tail pointing toward the Earth. NASA provides the flight opportunities, defines and integrates the payload, and maintains responsibility for mission management.

The USML program will use an Extended Duration Orbiter (EDO) capability which through use of additional cryogenic tankage in the cargo bay can extend flight duration up to 16 days The EDO kit offers an increase in total flight energy (kilowatt hours) over that provided in a fifth energy kit outfitted Orbiter. The USML program will also conduct experiments on which flight hardware is mounted on is the cargo bay and exposed to the space environment (rather than inside the pressurized volume offered by the Spacelab long module). This payload configuration is designated the United States Microgravity Payload (USMP).

Launch Date:	USML-1: March 1992	USMP-1: May 1992
	USML-2: August 1993	USMP-2: March 1993
	USML-3: November 1995	USMP-3: September 1993
Investigations:	TBD but anticipated to be on the order of 50-60	
Orbit:	297 km altitude, 28.5 degrees	
Duration:	13 Days	
Weight:	15,385 kg (max)	
Launch Vehicle:	Spacelab/STS	
Payload Specialists:	2	



USML-I Configuration

Mission Events

USML-1:
Authorization to proceed: June 1988
Mission PDR: October 1989
Mission CDR: July 1990
Cargo Integration Review: March 1991
Flight Readiness Review: February 1992

UNITED STATES MICROGRAVITY LABORATORY (USML) (Continued)

Management USML-1

NASA Headquarters
J. McGuire, Program Manager (Flight Systems Division)
M. Lee, Program Scientist (Microgravity Science and Application)
Marshall Space Flight Center
C. Sprinkel, Mission Manager
R. Nauman, Mission Scientist

Management USMP-1

NASA Headquarters
S. Smith, Program Manager (Flight Systems Division)
R. Crouch, Program Scientist (Microgravity Science and Application)
Marshall Space Flight Center
E. Valentine, Mission Manager
R. Nauman, Mission Scientist

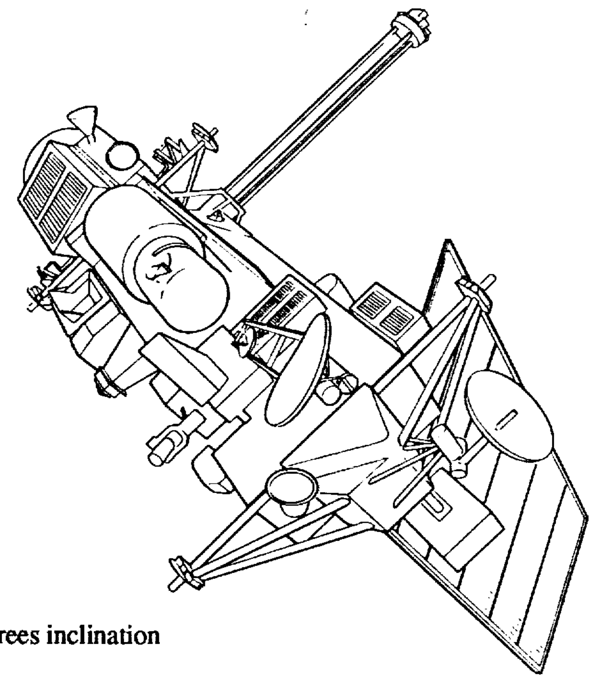
Status

USML-1 integrated payload requirements review is in progress
Science proposals for the payload complement under review
USMP-1 payload complement has been selected

UPPER ATMOSPHERE RESEARCH SATELLITE (UARS)

Objective

The Upper Atmosphere Research Satellite (UARS) will provide the global data base necessary for understanding the coupled chemistry and dynamics of the stratosphere and mesosphere, the role of solar radiation in driving the chemistry and dynamics, and the susceptibility of the upper atmosphere to long-term changes in the concentration and distribution of key atmospheric constituents, particularly ozone. It is a crucial element of NASA's long term program in upper atmospheric research, a program initiated in response to concerns about stratospheric ozone depletion.



Description

UARS will provide the first integrated global measurements of the chemistry, dynamics, and energetics of the stratosphere, mesosphere, and lower thermosphere. The mission consists of a free-flying experiment with nine instruments dedicated to upper atmosphere research and one flight of opportunity instrument.

Launch Date:	October 1991
Payload:	10 instruments
Orbit:	Circular, 600 km altitude, 57 degrees inclination
Design Life:	36 months
Length:	10.67 m (35 ft)
Weight:	6,818 kg (15,000 lbs)
Diameter:	4.58 m (15 ft)
Launch Vehicle:	STS
Foreign Participation:	Instruments: Canada, France, United Kingdom

Mission Events

Announcement of Opportunity: September 1978
UARS Experiment new start: FY 1982
UARS Observatory and central data facility new start: FY 1985

Management

NASA Headquarters
M. Luther, Program Manager
R. McNeal, Program Scientist
Goddard Space Flight Center
L. Gonzales, Project Manager
C. Reber, Project Scientist
Major Contractors
General Electric

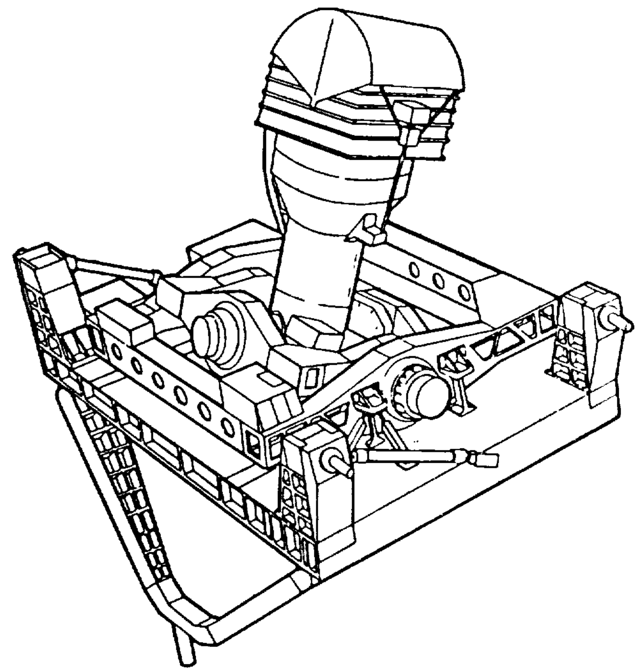
Status

All instrument CDRs complete
Observatory CDR complete

WIDE ANGLE MICHELSON DOPPLER IMAGING INTERFEROMETER (WAMDII)

Objective

- Measure global wind and temperature patterns as function of altitude from 80 to 300 km
- Observe the structure of waves and turbulence in these wind and temperature fields
- Study momentum transfer between the ionized and neutral winds
- Examine the fine structure of the wind and temperature fields in and near auroral forms



Description

The Wide Angle Michelson Doppler Imaging Interferometer (WAMDII) observes the Earth's airglow in order to map atmospheric winds and temperatures as a function of altitude in the vicinity of the Shuttle groundtrack. Filters are used to select one of several interesting spectral lines emitted by neutral oxygen molecules or ionized oxygen atoms. The Michelson interferometer is inserted into the optical path in order to observe an emission line that is Doppler shifted due to the velocity of the atmosphere relative to the instrument. An image near the Earth's limb provides data, integrated over the line of sight, on the vertical (altitude) and lateral distribution of emissions at a particular value for the horizontal component of the wind velocity. A nadir view gives a local map, integrated over altitude, at a particular value for the vertical component. Temperature information is deduced from the thermal broadening of an emission line and from ratios of emission line intensities.

WAMDII will be mounted in the Two-Axis Pointing System (TAPS), which provides image stabilization, offset pointing, and ground tracking capabilities. The Shuttle Payload of Opportunity Carrier (SPOC) will be used to meet the payload's need for power, command and data handling, and other support services. The mission team at the Payload Operations Control Center will monitor instrument performance and initiate commands for carrying out preplanned observational sequences.

Launch:	November 1991
Orbit:	300 km altitude at 28 to 57 degree inclination
Duration:	7 days
Length:	Approx 4 m
Weight:	Approx. 4,545 kg
Launch Vehicle:	STS

Mission Events

Preliminary instrument design: Completed
Mission concept, feasibility studies: Completed
Mission definition studies: Completed
Mission implementation: Ongoing
Instrument delivery to KSC: December 1990
Launch readiness date: April 1991

WIDE ANGLE MICHELSON DOPPLER IMAGING INTERFEROMETER (WAMDII) (Continued)

Management

NASA Headquarters
W. Huddleston, Program Manager (Flight Systems Division)
O. Storey, Program Scientist (Space Physics)
Goddard Space Flight Center
F. Volpe, Mission Manager
S. Chandra, Mission Scientist
National Research Council of Canada
R. Wlochowicz, Project Manager
York University, Canada
G. Shepard, Principal Investigator
Major Contractors
SED (a Canadian aerospace firm)

Status

The WAMDII instrument is currently undergoing design/development at SED, a Canadian aerospace firm located in Saskatoon, Saskatchewan (Canada). An instrument Critical Design Review is scheduled for May 1989. The pointing system to be used by WAMDII, the Two Axis Pointing System (TAPS), has under gone an acceptance test in support of the Astro-1 mission for use with the Broad Band X-ray telescope (BBXRT). GSFC is currently developing flight software and an instrument interface adaptor to establish compatibility between the WAMDII instrument and the TAPS. Acceptance for the software is scheduled for February 1990 while the adaptor is schedule for acceptance at GSFC in September 1989. Current planning reflects instrument delivery from Canada to the GSFC/WAMDII Program Office in July 1990 and shipment to the KSC in August 1991 in support of a November 1991 launch.

1.8 METER CENTRIFUGE FACILITY PROJECT

Objective

The 1.8 Meter Centrifuge project provides a suite of equipment designed to provide accurately controlled artificial gravity acceleration levels to support a broad spectrum of NASA Life Sciences research activities including:

- On-board 1-g experiments that serve as controls for micro-g experiments.
- Threshold gravity levels studies requiring accurately controlled variable gravity
- Countermeasure studies using regimens of varying artificial gravity levels on human surrogates
- Determining artificial gravity requirements for long duration spaceflight, e.g. manned Mars missions.
- Assessing the impact of long exposure to fractional gravity levels
- Fundamental biological studies in which the parameter of interest, gravity, is accurately controlled
- Studying the adaptation of experiment specimens to the spacecraft/spaceflight environment under 1-g conditions
- Validating extrapolated data from ground-based hypergravity studies

Description

The 1.8 Meter Centrifuge Facility is comprised of the following facilities:
1.8 Meter Centrifuge--A 1.8 meter diameter centrifuge which holds modular habitats and imparts centripetal forces to simulate gravity levels from 0.01 to 1.4 g's;
Modular Habitats--Units that will house either plants, rodents or small primates that will be tested in the centrifuge;
Glovebox--Provides the capability to conduct experiments in an environment biologically isolated from the crew;
Specimen Chamber Service Unit--The facility that will clean dirty cages or provide replacement cage\liners.

Foreign Participation: Broad international participation is anticipated with the 1.8 meter Centrifuge Facility

Program Events

Phase B Request for Proposal release: January 1989
Preliminary Requirements Review: August 1990
NASA Research Announcement: May 1991
Preliminary Design Review: June 1991
Critical Design Review: May 1992
Delivery of hardware to Ames Research Center: February 1994
Spacelab Launch: May 1995
Space Station Freedom Launch: Early 1996

Management

NASA Headquarters
L. Chambers, Program Manager
J. Wolfe, Program Scientist
Ames Research Center
A. Hargens, Project Scientist
Major Contractors
TBD

Status

A request for proposals for Phase B development of the Centrifuge Facility was released by Ames Research Center January 3, 1989. Responses to the request are due by March 6, 1989. A workshop to discuss the Centrifuge Facility is being planned for March 7-11, 1989.

MAJOR EVENTS FOR SPACE SCIENCE AND APPLICATIONS

MAJOR EVENTS
SPACE SCIENCE AND APPLICATIONS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1989	ARCTIC OZONE AIRCRAFT CAMPAIGN △	△		MAGELLAN □		COBE ○		VOYAGER II AT NEPTUNE △		GALILEO □		HST □
1990		○ ROSAT	ASTRO-1/ BBXRT □	GRO □		SLS-1 □ ○ CRRES				ULYSSES □		
1991	TSS-1 □	IML-1 □			ATLAS-1 □		S/L-J □	○ EUVE		UARS □	WAMDII □	S/L-D2 □ ○ SMALL EXPL-1
1992		△ ULYSSES JUPITER ENCOUNTER	USML-1 □		ACTS □ □ SRL-1 □ USMP-1	TOPEX/ POSEIDON ○ ATLAS-2 □ ○ SMALL EXPL-2	GEOTAIL ○ □ SLS-2	ASTRO-2 □	SHEAL-2 □ ○ MARS OBSERVER	IML-2 □		SMALL EXPL-3 ○ ○ WIND
1993		SRL-2 □	USMP-2 □		ATLAS-3 □	POLAR ○ SMALL EXPL-4 ○		USML-2 □	USMP-3 □	SLS-3 □		SMALL EXPL-5 ○

□ STS LAUNCHES ○ ELV LAUNCHES △ OTHER MAJOR EVENTS

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